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LONG-HOUR LIGHTING LOADS.

The advent of the season when the length of the days begins almost insensibly to grow shorter suggests the importance of cultivating long-hour lighting business in anticipation of the coming fall. Without depreciating the value of protracted power load, it is desirable to realize that the most extensive motor service cannot wholly offset the adverse influence of idle lighting equipment upon the larger economies of central-station operation, however beneficial power business may be upon the performance of the generating plant. More than once, experienced managers have pointed out the tendency of power-service expansion to overshadow the necessity of adding to the lighting load. Doubtless the profits of future central stations will in large measure be reaped from the sale of great quantities of electrical energy at extremely low unit prices, but the most enduring success demands that so far as practicable apparatus employed in distribution shall be operated within a close range of its capacity; otherwise the system suffers financially from the necessity of meeting fixed charges on an excessive investment.

The opportunities to secure long-hour lighting business are attractive in almost all communities where electrical service is recognized as reasonable in cost, convenient and safe in operation. The great trouble is that the public at large does not know the value of a complete electric-lighting service with high-efficiency lamps, and there is a delay in many central-station circles to establish rates which bring the benefits of both long-hour and off-peak lighting-current consumption home to the average householder and mercantile establishment. Considering the efforts put forth to establish the small fan motor it is surprising that so much remains to be done in the way of installing porch lights, pilot lamps for physicians' night bells and communicating equipment, permanent incandescents at the location of police and fire-alarm signal stations, the equipment of steam-railroad stations and baggage rooms with modern lighting facilities, and more general use of electricity in mercantile window displays. It is true that many of these individual installations are consumers of only trifling amounts of current, but the use of long-hour lighting service by devices of even small capacity means a desirable addition to income when widely distributed.

Among the larger opportunities for increased lighting service of the long-hour type, the average steam-railroad station is one of the most important, although admittedly difficult

to secure as a central-station customer in some cases, on account of the distance of the officers having jurisdiction from the local installation. However unfair it may be to judge a town by the appearance of its principal railway stations, the fact remains that such buildings are the front doors of the community. There is a distinct financial benefit to a growing city or town in possessing a well lighted station where the waiting passenger can read in comfort, and in most cases the service is prolonged until very late in the evening, if not maintained all night. The number of lamps required in and about such stations is considerable, and even if the company's policy is to cut off a considerable percentage of lamps as the evening advances, it is frequently necessary to maintain platform, sign and corridor lights well into the small hours. A central-station system will sometimes include the possibility of service in a dozen or more railway stations, but even in smaller communities the business is well worth securing. Well distributed lighting can be secured throughout a modern station much better by electricity than with gas, the ordinary central gas chandelier failing entirely to meet the conditions of illumination demanded by separate groups of patrons located in different portions of the station. From a dozen to a hundred or more lamps may easily be required in lighting small railway stations, and the revenue from these will frequently surpass that from installations containing three or four times the number of lighting units, with the added advantage of a lower idle investment.

Electric sign and window lighting continue to offer profitable earnings to the central station, when maintained upon a solid commercial basis. The tendency toward flat rates in this service is not seriously objectionable, since the maximum demand is known in advance, and there is no necessity for providing idle transformer capacity. There is an opportunity in many cases to improve the lighting of summer resorts within the range of central-station service, including both sign and residential work, and an attractive long-hour service is offered by many piers and wharves where boating is popular. Thousands of parks and recreation grounds can be lighted in better ways at moderate cost if the central station in the field is alive to its opportunities. Temporary wiring opens the door to many such installations. Hotels and clubs are also desirable long-hour lighting consumers, and throughout the important field of industrial night work from the newspaper office to the hospital there are excellent opportunities for the development of improved electric illumination.

CONVENTIONS ON SHIPBOARD.

Although the idea of holding a convention on shipboard is not essentially a new one, it is a little out of the beaten path for those states at least bordering on Lake Michigan. There are but few of the states, except those on our coasts, which have the opportunity of chartering a boat floating on a large body of water, but so successful has the recent convention cruise of the *Minnesota* been, and so profitably has the meeting been enjoyed by the members of the Michigan Electric Association, that one wonders why this has not been done oftener.

A convention on shipboard offers a number of advantages to both the members attending and to the salesmen who are continually looking out for the placing of orders. In the first place it is extremely easy to call members to meetings, and it is a fact that at this convention each meeting was attended by practically every member on board. In addition the heat and distracting noises of the city were removed, so that the members enjoyed a genuine outing and at the same time profited greatly by the subjects presented. The fact that the boat was equipped with wireless, and that commercial orders were sent in by this means is also rather unique.

Much praise is due to Mr. John A. Cavanaugh, president of the Association, who conceived the idea and applied his energies to its successful completion, and to Mr. Herbert Silvester, who as secretary and treasurer, assisted in its practical accomplishment. The precedent is one which it will be well for the Association to follow at future conventions.

GOING VALUE.

The question of the going value of a public utility, as distinguished from the value of its physical property, is one which has assumed considerable importance in connection with the subject of rate regulation, since it has an important influence upon the amount to be allowed for fixed charges. The courts have recognized the reasonableness of an allowance in the capital account for those expenditures which have been necessary in building up a business, but which do not represent any tangible property which can be appraised as constituting part of the investment.

While the existence of such elements of intangible value in a public utility is generally recognized, there is considerable lack of definiteness in the minds of many as to just what elements should be included in such a "going value," upon the value of which the rates charged should yield a return to the stockholder. There is also some difference of opinion on this matter among those who have given it close study.

A recent utterance on this subject by an authority in public-utility matters is of interest on account of the very clear way in which the elements which should properly enter into an estimate of going value are discriminated. In an article on "The Regulation of Public Utilities," in a recent issue of *The Voter,* Chicago, William J. Hagenah says:

"This value exists by virtue of the utility plant being a live, operating unit supplying service to those customers who have been induced to subscribe, thus giving to the company an established income in the development of which large expenditures have been made in one form or another, leading to the probable postponement of interest and dividend returns to the stockholders. Whatever single method should be

followed for determining the measure of such going value, the final calculation should be tempered with a consideration of fairness to all interests and a regard for the historical conditions under which the industry was developed.

"A public service corporation is entitled both by common law and by statute to a reasonable return upon its investment. If a given rate schedule yields more than a reasonable return to the investor it is an injustice to the public, and the rates should be lowered. If the rates fail to produce sufficient revenue, the investor is not receiving that return to which he is entitled by law. If he has received a reasonable return each year on his investment from the beginning of the enterprise, justice would seem to be satisfied, at least as against the public, without allowing any increase in the value of the property which produced that income to represent going value. If the investor has failed to receive each year that amount which constitutes a reasonable return, he should be permitted to charge rates sufficiently high to reimburse him for early losses, or such losses should be considered as costs of developing the business, and their addition to the value of the physical property permitted. Such additions, from an equitable standpoint at least, may be said to constitute the correct going value of a public service corporation.

"New plants seldom yield a return on the investment during the first year of operation. In fact, it is more likely to require a number of years of continuous effort to establish a business on a firm basis. The history of public utilities clearly shows that many of such plants have not reached a position of profit to the investor until many years after their construction. During the earlier years a large amount of money is required for development purposes. Where a corporation is in possession of adequate capital, expenditures of this character can be made without serious loss to the stockholders; but where, as is almost universally the case, the business is developed out of the earnings at the expense of interest and dividend payments, a deficit will result. When a corporation is earning less than its operating expenses, interest and depreciation, it is absolutely necessary that the stockholders make further payments for development purposes. Where a small surplus is earned, such amount may be used for development purposes, but it is at the expense of the stockholders' right unless such development requirements are recognized in the capital. If the development cost is not met out of the earnings, it must be met directly by the sale of securities, which becomes a liability against the plant.

"The amount by which the earnings fail to meet the operating expenses and the return on the investment creates deficits which constitute the cost of building up the business. Just as supervision, interest and insurance during construction are expenditures to be added to the construction cost of the plant, so the deficits representing the amounts by which the stockholders have failed to receive their reasonable return are costs to be added to the value of the physical plant in order to show the complete investment which has been made in the industry as a live, going concern. The investor has a right to expect reimbursement for such losses. They are legitimate costs of business.

"As an offset in favor of the public, equity also requires that if the deficits incurred in building up the business are to be regarded as a part of the investment, any surplus earnings, over and above a reasonable return on the legitimate investment, should also be taken into consideration. If the utility has earned in its later years a large profit because of favorable rate schedules, this excess above a reasonable return should be considered as a reimbursement for some of the early losses. The rule of justice should work in both directions."

Speaking of the value of a franchise, he says:

"If a franchise possesses any public value it must be such a value as will inure to the owners of the franchise because of the exercise of the privilege conveyed, subject to the legal and moral limitations surrounding it. Any value based on excessive rates is purely commercial and does not exist as against the public, since the franchise cannot justly be exercised for that purpose. Since a utility is at all times authorized to charge rates which will yield reasonable returns, it may be assumed that any commercial value which attaches to the franchise is due to the general desire on the part of capital to seek an investment from which a reasonable return can always be obtained without serious risk to the invested principal.

"It is apparent that no allowance should be made for franchise value unless the grantees have actually paid for such right. It does not necessarily follow that a franchise has no value. On the contrary, the franchises of large utilities are very valuable from a commercial standpoint, but when such rights are grants from the people to the companies without payment therefor, or without any restriction on the freedom of their most liberal exercise, the utilities have no investment as against the public upon which the public can be expected to pay a reasonable return.

"It may be accepted as an elementary proposition, the correctness and justice of which must appeal to every mind, that a franchise to operate a public utility should be granted with the least possible restriction in order not to increase the capital investment, and that the company when once supplied with the franchise should be left to develop its business without hindrance or restraint in order that a low rate for service may ultimately be obtained. To charge a large sum for the franchise only adds to the interest burden to be carried."

Mr. Hagenah has been actively engaged in the appraisal of public utilities in rate cases which have come before the Wisconsin Commission and he has also been engaged recently in the appraisal of the properties of the telephone and gas companies operating in the city of Chicago. His views in these matters have been already supported in part by the decisions of commissions and courts, and in consequence are entitled to the close study of those interested in public utilities and their regulation.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

ANNUAL CONVENTION HELD IN CHICAGO, JUNE 26 TO 30.

The twenty-eighth annual convention of the American Institute of Electrical Engineers was held in Chicago, June 26 to 30. The headquarters of the Institute were established at the Hotel Sherman and the attendance was in excess of that reached at any previous convention.

The convention was formally opened with a brilliant reception and dance in the grand ball room of the Hotel Sherman on Monday evening, June 26. The reception was followed by dancing and during the evening a delightful collation was served.

Among those in attendance at the reception were B. J. Arnold, A. W. Berresford, H. M. Byllesby, F. B. Crocker, Gano Dunn, Louis A. Ferguson, John F. Gilchrist, F. S. Hunting, Dugald C. Jackson, J. W. Johnson, E. B. Katte, A. S. Langsdorf, R. C. Lanphier, P. M. Lincoln, John W. Lieb, S. G. McMeen, N. J. Neall, H. E. Niesz, Ralph W. Pope, D. B. Rushmore, Charles F. Scott, C. E. Scribner, George F. Sever, Frank J. Sprague, S. D. Sprong, B. E. Sunny, C. P. Steinmetz, S. S. Wheeler, and H. M. Wilson.

The first technical session was called to order at 10:00 a. m. Tuesday morning, June 27, by President Dugald C. Jackson, who introduced M. Hoyne, who, on behalf of Mayor Carter H. Harrison, welcomed the members and guests of the Institute to the City of Chicago.

President Jackson then delivered the annual address. He called attention to the qualifications which the standards of professional conduct implied today, these standards placing the professional man in a position which demands from him an attitude of service and of leadership. He must have a masterly knowledge, in addition to skill in a vocation. He must deal practically in the affairs or needs of men. His duties must be performed with a disinterested spirit in addition to the vocational spirit of earning his livelihood. Such men have a duty to the public and in the performance of that duty they must exert their influence on that thought and purpose of the day which affects the welfare and progress of the nation. The members of the Institute as electrical engineers cannot escape that duty if they wish to maintain the professional character of their occupation.

Prof. Jackson analyzed the tendency of the day in the building up of great corporate interests and the very important place occupied by the engineer in shaping the distinies of these corporations in their relation to the community and to the world in general. The abatement of war eliminates to a considerable degree the activity of the military engineer and the constructive engineer is essentially occupying the field of greatest opportunity.

Engineers have a set duty as professional men who are trained and experienced in straight thinking to use their influence for the establishment and support of right and reason in the dealings between the public and the public service corporations. The problems surrounding the public service companies in American cities and their relations to the citizens should receive particular attention by members of the Institute, for those problems and those relations have been largely brought to their present importance and prominence through the activities of electrical engineers.

The balance of the meeting was devoted to the reading and discussion of technical papers on various phases of electrical engineering, including power station design and operation, electric-lighting, railways, industrial power, telegraphy and telephony, and high-tension transmission. There were a number of notable features of entertainment.

A full report of the technical proceedings with abstracts of the papers and of the principal points brought out in the discussion will be published in the next issue of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN.

American Institute of Chemical Engineers.

The third semi-annual meeting of the American Institute of Chemical Engineers was held at the Congress Hotel, Chicago, from June 21 to 24. Among the topics on which papers were presented were: chemical-engineering education, methods of attacking chemical industrial problems, industrial chemical calculations, practical value of calorific tests on anthracite coal, etc. There were numerous excursions to industrial plants in the vicinity.

Independent Telephone Company Plans Invasion of Greater New York.

Announcement has been made of the plans of an independent automatic telephone company to operate in Greater New York, and it is understood that a franchise will be sought through the purchase of the property of the American District Company of Brooklyn. It is understood that the new move is backed by Western capital which may be identified with the interests that are establishing automatic service in Chicago. The American District Telegraph Company of Brooklyn has always limited its business to messenger, patrol and burglar-alarm service, and operates under a charter given it by New York under the laws of 1848, which give it the right to engage in the telephone and telegraph business and to string wires anywhere in the State.

Increase in Production of Mica.

The total value of the mica produced in the United States in 1910, according to the United States Geological Survey, amounted to $337,097, exceeding by $56,568 the value of the production of 1909, and was greater than in any other year except 1907, when it amounted to $392,111. The production of sheet mica amounted to 2,476,190 pounds, valued at $283,832, an increase of 666,608 pounds in quantity and of $49,350 in value, as compared with the output of 1909. The production of scrap mica amounted to 4,065 tons, valued at $53,265, a decrease of 25 tons in quantity and an increase of $7,218 in value, as compared with 1909.

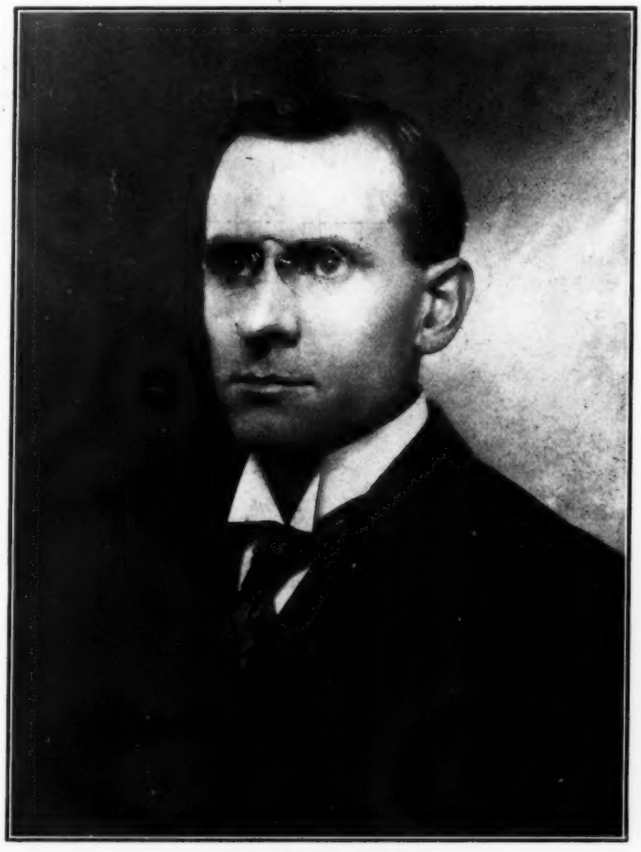
The production came from seven States: North Carolina, South Carolina, South Dakota, New Hampshire, Colorado, New Mexico, and Massachusetts, named in the order of the value of their output. The electrical industry consumes by far the greatest part of the sheet mica produced. The rough blocks as obtained from the mines generally yield only a small percentage of trimmed sheet mica, ten per cent being a very high yield.

Music by Telephone.

A company which was recently organized in New York has for its purpose, the transmission of music by telephone. The capital of the company is $1,000,000. It is announced that transmission lines are to be run from New York to Buffalo passing through Albany and intermediate cities.

Charles F. Scott.

In these days of intensive cultivation upon the part of the technical student it is fortunate that there are available as instructors to the aspiring engineer men who by breadth of experience, by technical training, and by special gift are eminently suited to act as preceptor and guide in the formulating of those impressions which are essential if the groundwork be well established. Dugald C. Jackson, president of the American Institute of Electrical Engineers, in his address at the annual convention of the Institute in Chicago this week, points out that the professional man must have a masterly knowledge of his subject as well as being skillful in the details that appertain to the application of this subject as an avocation. The demands upon the integrity and ability of electrical engineers in their relation to and their activity in the affairs of men make it highly desirable that in their instructors they find ripe experience, clear and clean perception of the fundamentals underlying the art and science, and in personality those desirable characteristics which it is the ambition of right-thinking men to emulate. Consequently, the announcement of the appointment of Charles F. Scott to the chair of electrical engineering at Yale University is a matter for commendation and is a source of gratification that American engineering has produced such a type of professional utilitarianism as Mr. Scott represents.



CHARLES F. SCOTT.
Who Will Teach Electrical Engineering at Yale.

Charles F. Scott has been well and favorably known to the electrical fraternity for a long period. He was born in 1864, at Athens, O., his early education being obtained at the Ohio University of Athens and later at the Ohio State University of Columbus, from which latter he graduated in 1885 with honors. He subsequently took a postgraduate course at Johns Hopkins University, at the same time teaching in the Baltimore & Ohio Railroad apprentice school. He then went into construction work with a company that was installing an alternating-current lighting plant in the Baldwin Locomotive Works.

Mr. Scott entered the testing department of the Westinghouse Electric & Manufacturing Company in the summer of 1888, commencing on night duty in the dynamo room, from which he graduated to the laboratory, where he assisted Nikola Tesla in his work on alternating-current motors. Later on he was given charge of the experimental work of the Tesla motor. After a time he was appointed assistant electrician. In 1897 he was made chief electrician of the company, continuing in that post until 1904, when he became consulting engineer of the company, which position he has held ever since.

Mr. Scott has represented the Westinghouse interests upon many notable occasions, has contributed a great many papers and reports to the national engineering societies, has been a prolific contributor to the technical press and has taken a leading part in the discussion of various phases of electrical development before the American Institute of Electrical Engineers and other technical and engineering societies. He has given the subject of the education of the electrical engineer a great deal of study and his addresses on this subject have indicated a comprehensive knowledge of the duties and requirements of the competent instructor and his relation to the peculiar human problem presented by the technical student.

Mr. Scott was president of the Engineers' Society of Western Pennsylvania in 1902 and was president of the American Institute of Electrical Engineers in 1902 and 1903. He was chairman of the building committee and has always been an indefatigable worker in the cause of his brother engineers. He has been an ardent advocate of the system of sections and branches in the American Institute and has taken a very active and personal interest in their success.

Resistance of Mercury at Very Low Temperatures.

In the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for June 24, results of experiments carried on by H. Kamerlingh Onnes, professor at the University of Leyden, on the resistance of gold and platinum at very low temperatures, were given. He has recently carried out similar experiments upon the resistance of pure mercury at the low temperatures which are obtainable by the use of liquid helium.

It was found that the resistance of solid mercury at 13.9 degrees on the absolute scale is 0.034 times the resistance at zero degrees centigrade (extrapolated); at 4.3 degrees it is 0.00225, while at 3.0 degrees absolute it falls to less than 0.0001. These experiments add weight to the opinion previously expressed that the electrical resistance of pure metals, if brought to the absolute zero, would become zero, or at least differ inappreciably from zero.

In the course of these experiments it was demonstrated that liquid helium is an excellent insulator. It was consequently possible to make the resistance measurements with bare wires. It was also shown that liquid helium could be successfully transferred from the apparatus in which it was liquified to another vessel.

Annual Conventions of the Master Mechanics' Association and the Master Car Builders' Association at Atlantic City.

The annual convention of the Master Mechanics' Association was held at Atlantic City, N. J., June 14, 15 and 16. The sessions were devoted to a consideration of reports of various committees and on Friday the following officers were elected: President, H. T. Bentley, Chicago & Northwestern; first vice-president, D. F. Crawford, Pennsylvania Lines; second vice-president, T. Rumney, Erie; third vice-president, D. R. MacBain, Lake Shore & Michigan Southern; treasurer, Angus Sinclair; executive committee members, C. A. Seley (C. R. I. & P.), E. W. Pratt (C. & N. W.) and J. F. Walsh (C. & O.).

The annual convention of the Master Car Builders' Association was held on June 19, 20 and 21, a number of important reports being read and discussed, and the following officers were elected: President, A. Stewart, Southern Railway; first vice-president, D. F. Crawford, Pennsylvania Lines; second vice-president, C. E. Fuller, Union Pacific; third vice-president, M. K. Barnum, Illinois Central; treasurer, J. S. Lentz, Lehigh Valley. The Executive Committee is composed of F. W. Brazier, (N. Y. C.); C. A. Schroyer, (C. & N. W.); and A. Kearney, (N. & W.)

The exhibit of the Railway Supply Manufacturers' Association was very complete. The following companies were among those making elaborate exhibits:

Dearborn Drug & Chemical Works, Chicago, Ill.; Joseph Dixon Crucible Company, Jersey City, N. J.; Edison Storage Battery Manufacturing Company, Orange, N. J.; Electric Controller & Manufacturing Company, Cleveland; Electric Storage Battery Company, Philadelphia, Pa.; Fairbanks, Morse & Company, Chicago, Ill.; General Electric Company, Schenectady, N. Y.; H. W. Johns-Manville Company, New York, N. Y.; Kerite Insulated Wire & Cable Company, New York, N. Y.; Pyrene Manufacturing Company, New York, N. Y.; Sprague Electric Works of the General Electric Company, New York, N. Y.; United States Light & Heating Company, New York, N. Y.; Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.; Westinghouse Lamp Company, Bloomfield, N. J.; Westinghouse Machine Company.

At the annual meeting of the Supply Manufacturers' Association the president announced that last year the exhibits aggregated 71,453 square feet, whereas this year they covered 76,110 square feet. The number of exhibitors in 1910 was 238, and this year the number was 250.

The report of the nominating committee presented the names of B. E. D. Stafford, Flannery Bolt Company, Pittsburg, Pa., for president, and Samuel G. Allen, Franklin Railway Supply Company, New York city, for vice-president. These gentlemen were eleced unanimously. Subsequently President Stafford announced the following officers and committees for the convention of 1912:

Treasurer—Herbert I. Lord.

Secretary—John D. Conway.

Finance committee—Charles P. Storrs (chairman), A. C. Ashton and George N. Riley.

Exhibits committee—J. Will Johnson (chairman), E. H. Walker, John R. Blakeslee and Frank J. Lanahan.

Badge committee—E. H. Walker (chairman), Samuel Allen and Lucien C. Brown.

Entertainment committee—Philip J. Mitchell, chairman. (Mr. Mitchell will name the members of the committee at some future time.)

Enrolment committee—Oscar F. Ostby, chairman. (Mr. Ostby will name his committee later.)

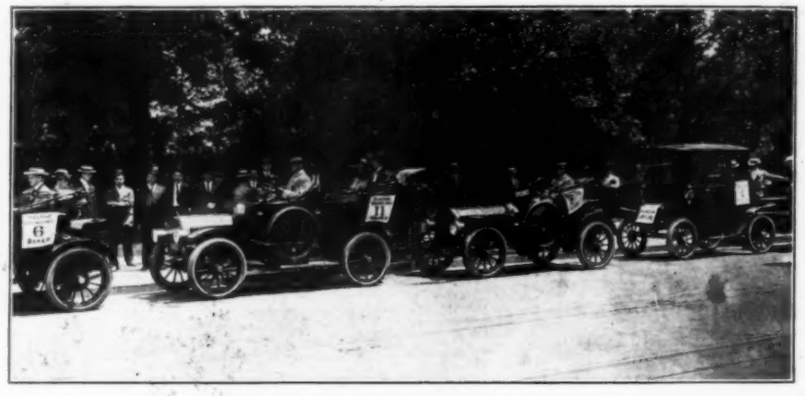
Transportation committee—George S. Stuart, chairman. (The makeup of the committee will be prepared later by Mr. Stuart.)

One of the features of both the Master Mechanics' and Master Car Builders' conventions was the excellent *Convention Daily* published by the *Railway Age Gazette*.

Electric-Vehicle Contest.

A demonstration of electric pleasure vehicles, out of the ordinary, was the "suburbaning contest" held on June 14 by the Electric Automobile Dealers' Association of New York City. Differing from usual runs, the object was neither speed nor distance, but rather the exposition of the virtues of the electric for suburban use on the part of the average individual.

Four experts covered the course in the various cars entered, and each of these men estimated the time in which the trip should be made in order to afford the most pleasure and recreation. For the keenest enjoyment of an automobile trip when diversion and seeing the country are the only objects sought it is quite generally conceded that the speed should not exceed fifteen miles per hour. So the average time of the four experts was set as the ideal time for the course.



START OF ELECTRIC-VEHICLE CONTEST.

The route laid out covered 38.6 miles over a beautiful section of Long Island. The start and finish were at Columbus Circle and luncheon was served at Bellrose. Eleven cars were entered; two Rauch & Lang; four Detroits and five Bakers. Since the prize did not call for strength or the skill of professional chauffeurs, ladies were welcome, and Mrs. C. Y. Kenworthy drove one Rauch & Lang car, while Mr. Kenworthy piloted another. Entrants were divided into two classes; Class A, for gentlemen, and Class B for ladies.

The judges decided that the normal time for the run was three hours and thirty-one minutes. The winner of the Class A prize proved to be R. E. Darling, driving a Detroit, whose time for the run was three hours and twenty-seven minutes. Mrs. C. Y. Kenworthy won the Class B. prize.

Electrical Equipment of a Naval Training School.

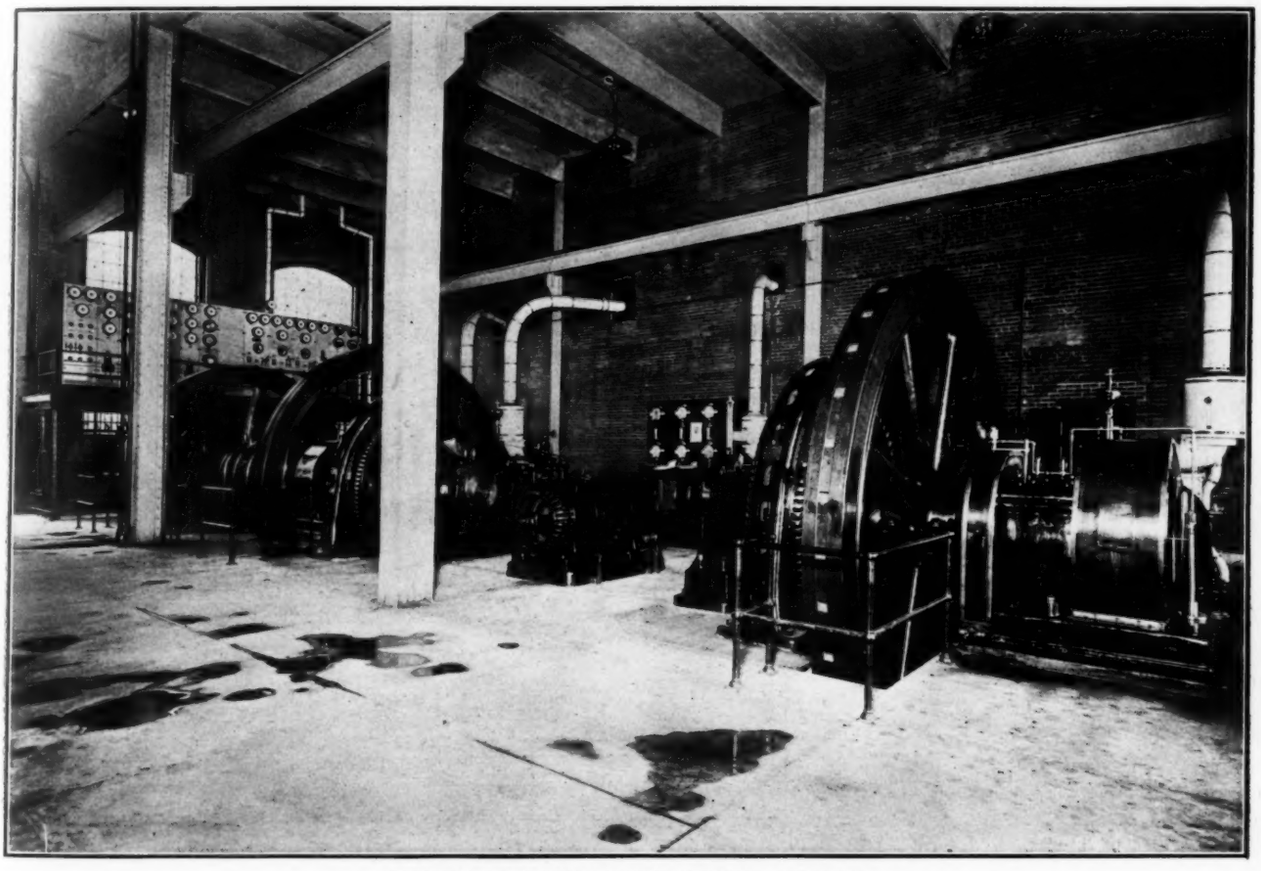
Generation, Distribution and Utilization of Electrical Energy at the Recently Completed Great Lakes Station.

Considerable importance attaches to the opening, on July 1, of the $3,500,000 United States Naval Training Station, Great Lakes, located at North Chicago, Ill., on account of its being the most comprehensive institution of its character in existence and also on account of its being the first inland station for naval recruits.

From an engineering point of view much of interest has been accomplished. The reservation presented to the Government for the station comprises 182 acres, fronting on Lake Michigan. Four deep ravines extended over this tract, which added greatly to the difficulty of constructing the various buildings with any degree of symmetry. However, as the plans called for an inner basin on the lake front, over 60,000 cubic yards of material were excavated from the site of this basin and deposited in the ravines, and one of the ravines thus filled was used as a building site.

Other work of unusual interest was the construction of a timber and concrete sea wall surrounding the entire inner basin; the construction of a pile revetment 600 feet in length for the protection of the sewage-disposal plant; a timber-crib sea wall was constructed to make a site for the location of a power house and filtration bed; a pipe-conduit bridge was constructed across the main ravine to carry sewer, water and heating pipes and electrical transmission lines; one ornamental concrete arch bridge and one steel bridge were constructed along the driveways across ravines.

Forty-one buildings have been constructed, these comprising the administration building, instruction building, drill hall, power house, mess hall and galley, four main barracks, main guardhouse, receiving guardhouse, receiving building, receiving galley and laundry, six receiving barracks, general storehouse, brig, stable, boat house, commandant's house, thirteen houses for officers' quarters, a hospital building, a hospital-laundry building, sewage-disposal plant, water and filtration plant. In addition, there is now under contract a modern five-ton garbage crematory. All of these buildings are completed and accepted with exception of the hospital, on which there is a but a relatively small amount of work yet to be done. The buildings are all of reinforced concrete, brick and steel with fireproof concrete roofs. It has been estimated that the cost of constructing the buildings was eighteen cents per cubic foot.



GENERATING ROOM AT GREAT LAKES STATION.

Briefly stated, the buildings are located as follows: Fronting Sheridan Road are the receiving buildings, which appear to be isolated on account of a thickly wooded tract and a ravine which separate them from the station proper. Immediately east of this tract

are the four barracks, with the mess halls, guardhouse and stable due north. The barracks are at the extreme west of a forty-acre parade ground; the administration building being at the eastern extremity. North of the parade ground, extending from the barracks to the administration building, is the drill hall, instruction building and storehouse. The officers' quarters are east of the administration building, fronting Lake Michigan, and the power house is on the shore of the lake at the northeast extremity of the tract.

The power plant is a central heating and power plant for the entire station, supplying heat, light and power to all of the buildings. The station is designed at the present time for 1,500 men, but the grounds have been so laid out and the power-plant building so designed as to be capable of ready expansion to a probable ultimate capacity of 2,500 men.

The power-plant building, three stories high, houses the central heating plant, the electrical machinery, the water and fire-service equipment, the refrigerating plant, and the station machine shop, together with the usual offices, toilet rooms, etc. The problems of coal handling and water pumping were considerably simplified by locating the power house at the foot of the bluff, approximately at lake level, some seventy feet below the level of the main plateau, on which the main buildings are located. The building is founded on piles and is of fireproof construction throughout, being of brick and terra-cotta, and conforming in general to the architecture of the other buildings of the station.

The boiler room on the first floor is ninety feet long by forty feet wide and houses six 300-horsepower Babcock & Wilcox standard 150-pound-pressure boilers, in three batteries of two boilers each. A view of this installation is shown in one of the accompanying illustrations. There is ample room for doubling this boiler capacity, and the circular brick stack, 180 feet high and 11 feet 6 inches in diameter, is designed for such increased boiler capacity.

The stokers are the Roney type, with a grate surface of sixty-four feet per stoke, and with an unusual arch depth of eight feet; this increased depth being a protection against smoke.

The coal is handled by gravity from bottom-dump cars, which are run from the spur track connecting with the Chicago & Northwestern Railway across the trestle connecting the power-house roof with the main plateau. This spur also connects with the Chicago & Milwaukee Electric Railroad, the necessary trolley conections being made. These cars dump the coal into steel hoppers suspended from the railroad track into an electrically propelled and operated coal crusher which has a capacity of some sixty tons per hour. This coal crusher, which is equipped with a twenty-five-horsepower motor, is located between the railroad track and the roof of the boiler room, as shown in one of the illustrations. The coal drops from the coal crusher directly into coal bunkers, having a capacity of 500 tons, which are directly over the boilers. From the bunkers the coal falls through traveling chutes directly into the Roney stokers, the chutes being equipped with weighing scales. The ashes drop by gravity into the subbasement below the boiler room into ash cars which connect with a hydraulic ash hoist. This elevates the ashes about seven feet to the power-house grade, from which the ashes are distributed along the beach south of the power house by cars traveling on an industrial track. The cinders thus deposited become an aid in building up and maintaining the beach, protecting the bluff from erosion by the lake. The boiler room is also provided with seven Foster automatic non-return boiler stops by means of which the boilers can be cut out, in case of emergency or when making repairs, from any part of the station.

All coal is bought on the British-thermal-unit basis, the specifications calling for at least 12,000 units, although no premium is offered for excess. No coal is accepted unless delivered in bottom-dump cars.

POWER PLANT. RAILWAY TRESTLE ON LEFT CARRIES ALL SERVICE PIPES AND LINES TO TUNNEL ENTRANCE.

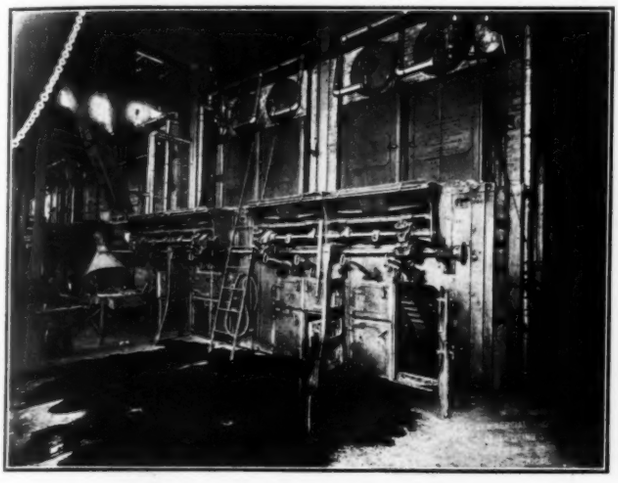
All high-pressure steam piping is of welded steel, no cast joints being employed. The main steam header is ten inches in diameter, with eight-inch auxiliary bends leading from it to the engines.

The boiler room and engine room are located on the first floor of the plant, a fireproof brick wall separating the two. The engine room is also

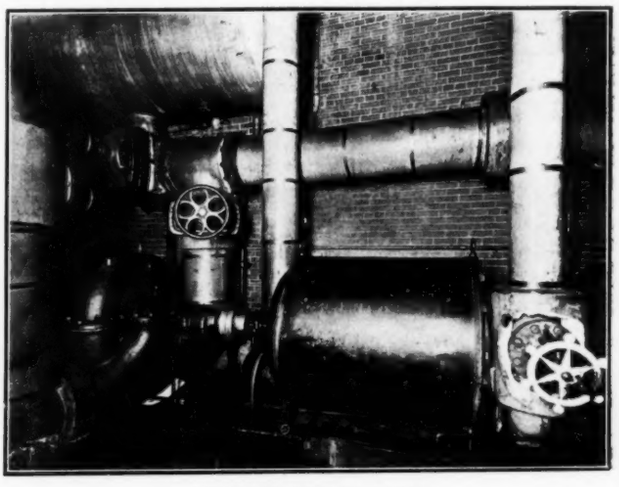
ninety feet long by forty feet wide. As may be seen in the accompanying general view, the main generating units are located in a row in the center of the room, the switchboard being installed on a gallery at the west end.

In the engine room there are three 175-kilowatt Western Electric, 2,300-volt, sixty-cycle, three-phase alternators, direct connected to three eighteen forty-five-kilowatt, 125-volt compound-wound generator running at 1,200 revolutions per minute, connected to a sixty-cycle, three-phase, 2,300-volt squirrel-cage induction motor. A seven-ton hand train is placed in the engine room.

The switchboard is of blue marble, comprising fourteen panels. From right to left, facing the switchboard, which is pumped from the central power plant. Located directly back of the boilers there are two ten-inch horizontal double-suction centrifugal D'Olier pumps direct connected by flexible couplings to two 150-horsepower Kerr high-pressure steam turbines operating at 2,300 revolutions per minute. These pumps, which are shown in one of the accompanying illustra-



PORTION OF BOILER ROOM.



TURBINE-DRIVEN PUMP.

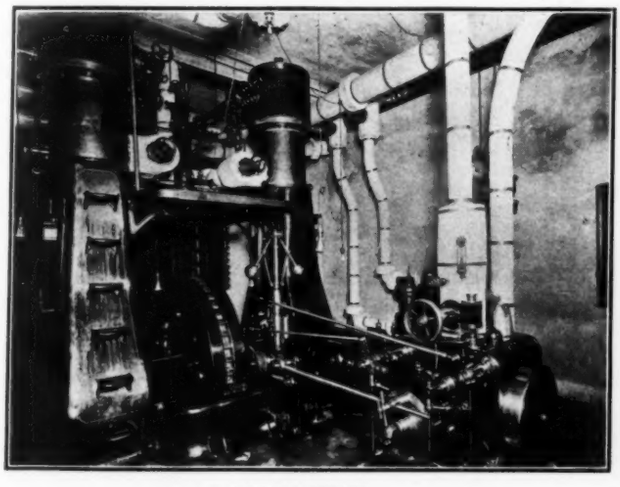
by thirty-six-inch simple horizontal non-condensing Bates heavy-duty Corliss engines, operating at 120 revolutions per minute, of 250-horsepower capacity each. Foundations are constructed for a fourth unit to be installed when required. There are two exciters, one engine-driven set consisting of 47.5-kilowatt, 125-volt compound-wound generator running at 300 revolutions per minute, direct connected to an 11 by 10 Ames horizontal simple engine; and one motor-generator set consisting of a Western Electric

these panels are divided as follows: Two exciter panels, three generator panels, one blank, one totalizing panel, six feeder panels, and one station panel. The board is equipped with the usual complement of instruments and all are of Westinghouse make, with the exception of the Tirrill regulator for regulating the voltage. There are five outgoing feeders and three arc circuits, the latter being equipped with Western Electric regulators.

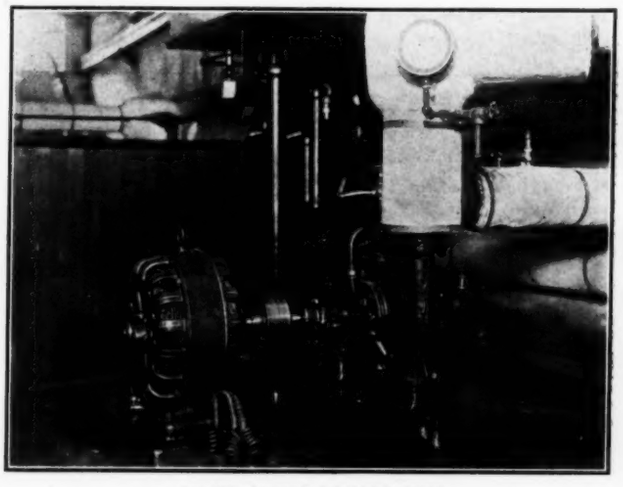
All direct radiation throughout the buildings is supplied by hot water,

tions, have a capacity of 2,500 gallons per minute. Although the steam consumption of these units is high, this does not reduce the efficiency of the plant, as the steam is condensed in the exhaust heater for heating the circulating water.

The other pumps, with the exception of the two American boiler-feed pumps, are located in the basement. The main service pump for water service is a compound 10 by 16 inch, with a capacity of 400 gallons per minute. In addition there are two Underwriters' fire



ICE MACHINE.



CIRCULATING BRINE PUMP.

pumps, each 16 by 9 by 12, with a capacity of 750 gallons per minute against a pressure of 150 pounds. The fire pumps and mains have been so designed as to be capable of throwing from four to six fire streams to the top of any building.

In addition to the hot water which is circulated for all direct radiation, there is also supplied to each building live stream which supplies the stacks for the ventilating fans, for cooking purposes in the gallery, and for use in the main laundry of the station; also for supplying hot water for bathing and domestic purposes, for the swimming tank, disinfecting, etc. The hot-water circulating system is that known as the Evans-Almirall system.

Also located in the basement in an isolated room adjoining the pump room, there is installed a complete ice-making and refrigeration equipment. The ice machine is a thirty-ton single-acting vertical machine of York manufacture. The freezing room is provided with ninety-nine 200-pound cans. Brine is circulated, by means of a circulating pump driven by a five-horsepower motor, to the various ice boxes in the galleys. The plant is equipped with a motor-driven brine agitator, the motor being of three-horsepower capacity with vertical shaft. In connection with the ice plant there is installed a recording steam meter which measures the amount of steam consumed by the ice machine.

The mezzanine floor of the plant is fitted up as a store room, and a fully equipped machine shop is located on the third floor. The machines installed comprise a lathe, drill presses, shears, pipe-bending machines and all are driven by individual induction motors. The machine shop is also equipped with an oxy-acetylene welding outfit.

One of the features of the Naval Training Station is the comprehensive system of tunnels, connecting practically all of the buildings, in which the steam and hot-water pipes and electrical distribution mains are carried. The tunnel is 6 by 6 feet square and its approximate length is 3,500 feet. All branches are carried in concrete slab conduit. Outside the tunnel the electrical mains are carried in vitrified conduit.

Elaborate provision has been made for filtering and storing the water used in the plant and distributed to the station. A water-intake pipe fourteen inches in diameter extends out into the lake 1,200 feet and the water is pumped into a modern sand filtration plant, housed in an isolated building directly opposite from the power plant. An interior view of this building is shown in one of the accompanying illustrations.

The interior is divided into two bays, one for the raw water and one for the filtered water. The raw water is filtered through four feet of sand and then enters the storage basin where it is held ready for use. A pump, driven by a two-horsepower motor, delivers the water to the power plant where it is first measured and then distributed to the various stand pipes. The filtration plant is of sufficient size to filter 200,000 gallons of water daily, and has storage capacity for 400,000 gallons.

Upon leaving the station the current is transformed to 110 volts for lighting and 220 volts for power, by means of subway transformers located in the tunnel. Tungsten, tantalum and carbon lamps have been used extensively for interior illumination, an exception being the immense drill hall where sixty-six multiple, 110-volt, sixty-cycle arc lamps are installed. The entire grounds, driveways, and bridges are illuminated by arc lamps suspended from standard steel posts. There are approximately 8,000 incandescent lamps and 140 arc lamps installed, 100 of the latter being used for interior lighting. The arcs used for exterior lighting are of the series type.

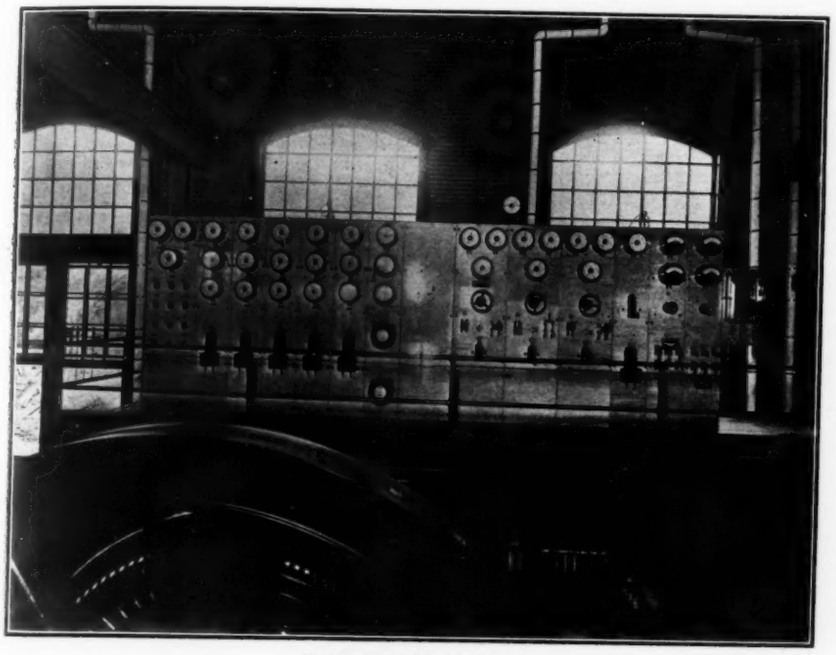
Motors have been extensively employed in all departments of the station, the total capacity aggregating 350 horsepower. In addition to the elevator motors in the administration building and hospital there are a number of motors driving ventilating fans for the indirect heating of the larger buildings; motors in the kitchen for operating ice cream freezers, dough mixers, vegetable parers, and bread slicers.

All motors are controlled from separate starting panels and all lighting and power circuits are carried in iron conduit concealed in the walls.

In the hospital, which is isolated from the other buildings, every modern convenience has been employed. One of the features of the electrical installation in this building is the visual signal system. When a patient calls a nurse a white light, of candlebra size, is lighted at the nurses' station and also over the door of the room in which the patient is calling. These lamps remain lighted until cut out by an automatic switch installed in the door jam of the room. There are also emergency switches in each room, which on being closed, light a red lamp in similar positions. In the diet pantry of the hospital provision is made for electric cooking on a small scale. The hospital is also provided with individual refrigerating plant.

TRAVELING COAL CRUSHER OVER BUNKERS.

Another point of interest at the Training Station is the electric clock system, a master clock controlling all of the secondaries.



MAIN SWITCHBOARD.

The station has been constructed under the command of Rear Admiral Albert Ross, U. S. N. The engineering

WATER-FILTRATION PLANT.

work has been under the supervision of Civil Engineer George A. McKay, U. S. N., followed by Civil Engineer C. D. Thurber, U. S. N.

World Dictionary of Scientists.

The need of a book of reference containing the names, appointments and achievements of the world's foremost scientists has long been felt in learned circles. J. & A. Churchill have in preparation a new annual which is designed to meet this want. It will be be called "Who's Who in Science," and is to be edited by H. H. Stephenson.

Schedules are now being addressed to the scientists whose names may appear, and it is hoped that they will assist the publication by filling in and returning the forms to 7, Great Marlborough Street, London, England.

Escape of Gas from Coal.

In a paper just issued by the Bureau of Mines, H. C. Porter and F. K. Ovitz say that it is a matter of common knowledge that inflammable gas made up chiefly of methane, which forms with air the so-called fire damp of the miner, escapes from the coal in many mines; yet little is known as to the condition of this gas in the coal, its quantity and rate of escape.

Gas escapes from coal not only during the breaking down of the coal in the mines, but also continuously for a long time after the coal is mined. In one test, during the first two weeks after mining, there was set free by one coal, exclusive of the gas that escaped during mining, a volume of methane equal to three-fourths of the volume of the coal itself. During the first five months after mining there was set free from this coal a volume of methane equal to one and three-fourths times the volume of the coal.

The results of the experiments show that certain American coals liberate gas not only while they are being broken down in mining, but also during a long period thereafter. At first the gas escapes rapidly, but the rate diminishes and tends toward a final cessation in three to eighteen months. About one-fourth volume of methane escapes during the crushing of the coal, and one-half to one and one-half volumes on continued exposure to the air. The loss of fuel value by this loss of gas is small, but the danger of accumulation of explosive gas from this source in mines and in coal bunkers is sufficient to justify its being taken into account in the ventilation of mines and in the storage of coal.

Growth of Traffic in Simplon Tunnel.

In a recent number of an Italian journal is given an interesting table showing the steady growth of traffic through the Simplon Tunnel in the Alps. The data are as follows:

Year.	Passengers Carried.	Tons of Freight Moved.
1906	260,000	26,000
1907	365,000	75,000
1908	375,000	81,000
1909	376,000	102,000
1910	497,000	135,000

The Michigan Electric Association.

Annual Meeting on Board the Steamship, Minnesota, June 19 to 22.

The most enjoyable and profitable convention in the history of the Michigan Electric Association was held on board the Steamship *Minnesota*, which sailed from Grand Haven, Mich., on the evening of June 19. The unique idea of holding the sessions of the eighth annual convention on board ship, which was conceived by President Cavanaugh and Secretary Silvester, was well carried out in every detail.

Although the boat was remodeled from a freight boat, the appointment was complete and everything possible was furnished for the comfort and enjoyment of those making the trip. The pleasant weather which continued through the three days on board ship also added greatly to the enjoyment of the outing.

Some idea of the attendance may be had from the fact that there were, in all, twenty central stations represented; the number of representatives being forty-nine. There were also present forty-eight manufacturers' representatives from thirty different companies.

In opening the first session of the convention on Tuesday morning, J. A. Cavanaugh, president of the Association, spoke briefly regarding the Railroad Commission, which has complete control of the rates of all light companies' operation in the state. He also recommended the maintenance of a scholarship at some good university. By placing such a scholarship with the University of Michigan at Ann Arbor, the Association could have at its disposal the results of valuable research work. The gas companies have at present such a scholarship. Mr. Cavanaugh further recommended that the members be kept in closer touch with each other.

Before the reading of the first paper Mr. Cavanaugh announced the members of the nominating committee as follows: F. B. Drees; Ora S. Wood, and H. Ai. Chase.

The first paper, prepared by James R. Cravath, but read by O. H. Caldwell, follows.

THE CENTRAL STATION FROM A CONSULTING ENGINEER'S VIEWPOINT.

Mr. Cravath's remarks were confined mainly to small central stations operating in communities of 15,000 population and less. In such companies it has been the observation of the writer that there have been two elements of weakness: (1), a general lack of good business methods, and (2) a lack of electrical knowledge by those in charge. Many central stations are controlled by men with but little knowledge of electricity. Several instances were given of cases where too much dependence was placed on men with insufficient knowledge, and where the result had been the installation of unnecessary machinery. The point of keeping the financial and technical parts of the business was dwelt upon, inasmuch as in this way alone can the operating men make necessary provision for future growth of the business. One company which does engineering and operating work refuses to operate any company of which it has not financial control. The thing of first interest in connection with any company is of course the net earnings after paying interest and depreciation. These earnings are, naturally, dependent upon many factors. One of the first things to be looked at in connection with the central station is the amount of liability per kilowatt of station capacity. If there is much reserve capacity, the liabilities per kilowatt of peak load should also be included. For this item $250 per kilowatt is frequently considered a fair average figure for smaller stations such as we are considering. In large cities they run much higher mainly on account of the large investment required in distributing plants and lines. This factor gives an idea as to the amount of burden in the shape of fixed charges which the company must carry for a given amount of earning capacity. The gross income per kilowatt of station capacity varies all the way from $50 to $140. The higher this gross income, the most profitable the undertaking is likely to be. As a general proposition, central stations operating in towns having a population between 3,000 and 8,000 are able to show the highest net returns on the money invested, although frequently they do not make such a showing. There are some inherent reasons why with good management plants in towns this size are able to show the highest net returns. In the first place the investment in distribution systems is considerably lower than in the larger cities and plant real estate is also cheap. The earnings per kilowatt of station capacity, however, are usually fully as high as in the larger cities. The result is that the better managed of these smaller plants will earn gross each year from thirty to forty-five per cent of the investment or liabilities, where the larger stations will only earn from eighteen to twenty-five per cent. The ratio of operating expenses to gross receipts is likely to be a little higher in the smaller plant—that is, from sixty to sixty-five per cent for the smaller plant as against fifty to fifty-five per cent for the larger plant, but this does not make up for the great difference in fixed charges.

It was remarked in connection with this paper that unscrupulous salesmen sometimes did sell machinery not needed, although the discussion brought out the fact that this was the exception and it happened very infrequently.

The following paper, dealing with office management, was then read by A. P. Biggs, of Detroit.

THE UNWRITTEN LAW OF AN ELECTRIC LIGHT COMPANY.

The question of verbal contracts, written contracts and the things which a company is expected to do of its own accord were considered in Mr. Biggs' paper which also took up the subject of the discipline and other laws necessary for the preservation of the assets and reputation of the company. Many customers come with questions regarding the cost of installing service and meters, the renewal of lamps, the wire required for motors of various sizes, etc. The representatives of the company should be fully informed on these points, or customers cannot be blamed for having rather a poor opinion of the operating company. The sales department should have a booklet with explanation of policy and rates, information on the securing of business, and much data on any processes in which electricity in any form could be used. The small plant, if it would grow, must have at hand continuously such information as that just noted. If the department is to be the sole representative to meet customers, the instruction book should give the details of the work of other departments by which the customer is effected.

For the benefit of employees there should be rules put up in every department setting forth the way in which detail work should be done. Accurate and accessible records of all work should be kept on file and every point in the relations of each customer with the company recorded. Such a method of procedure often succeeds in holding a customer where all other methods fail. To avoid all mistakes there should be an orderly and conveniently written law covering those things which constitute throughout the company, its standard practice. "Efficiency is both attained and maintained by the help of written instructions, thus detecting and eliminating much that is arbitrary, thus saving from oblivion much that is of value."

F. B. Drees, of Lansing, opened the discussion, stating that the Lansing Power Company had re-organized its methods of handling business and was having a very small number of complaints. In the first place a verbal promise was never made, and moreover, a written contract was never given unless it was certain to be carried out. Meter readers were told not to try to explain difficulties, but to refer the complainant to the office where he could obtain a full and satisfactory explanation. As a result of this policy there is universal satisfaction among the customers of this company. Speaking along the same lines, Mr. Cavanaugh also brought up the subject of the written contract with the consequent avoidance of trouble.

The method of modeling the service to fit conditions was mentioned by A. D. Furlong, of Pontiac, who also stated his belief in holding meetings of em-

ployees with the idea of securing full co-operation from them. Mr. Drees added that in his company a meeting lasting from fifteen to thirty minutes was held every day, so that the heads of all departments might consult. Such meetings were found to be productive of many new ideas and resulted in the broadening of the entire force. A paper, which follows in abstracted form was then read by R. W. Hemphill of Ann Arbor.

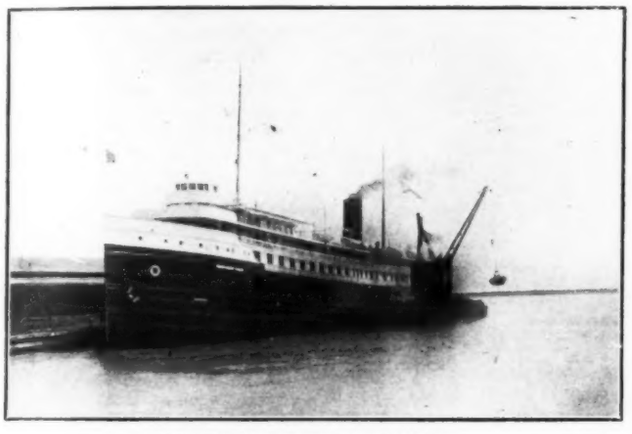
IMPROVED STREET LIGHTING.

The paper read by Mr. Hemphill followed the progress of the arc lamp since its invention by Jablochkoff in 1876 and touched on the search for an electrode which would give a longer life than was possible with carbon. In the luminous arc this was accomplished and we have an upper electrode composed of a solid copper rod inclosed in an iron tube. The lower, or negative electrode, is of magnetite and is also inclosed in an iron tube. In this lamp the majority of the light is thrown at an angle of ten degrees below the horizontal. With the advent of this lamp prices of service have diminished greatly. While early contracts called for $135 per lamp per year the standard price now is $60 per lamp per year for all-night lighting. In some places even a lower rate is possible. As an auxiliary to the arc the tungsten has also found a wide field, and the ability to operate these lamps on the arc circuit greatly enhances their value. An ideal system on this principle has been installed at Ann Arbor. The installation, which was briefly described, consists of 184 four-ampere magnetite-arc lamps, and 187 seventy-five-watt sixty-candlepower tungsten lamps. The luminous arc lamp has the advantage of: (1) less energy consumption per unit of illumination; (2), ideal distribution; (3), long life of electrodes; (4), simplicity of design; (5), absence of enclosing globe.

There are also disadvantages, such as weight and the requirement of a moderately high temperature. Tubes are often ruined by trying to start the lamp at too low a temperature. A saving is also accomplished in line loss in a change from 6.6 ampere enclosed arcs to a four-ampere luminous-arc system. The standard of the lighting is, naturally, raised by such a change. Taking up the question of series tungsten lamps the author mentioned the fact that many of his lamps had had a life of over 6,000 hours and many more as much as 5,000 hours. With the Ann Arbor system of lighting, ornamental concrete poles were installed at a cost which was very low. These poles are twenty-five feet in length, eight inches at the base and five inches at the top. Iron rods were used for reinforcing. The cost of ten forms for making these poles was $200 and the cost of making 100 poles amounted to $747.84. Each pole weighed 1,185 pounds. So satisfactory has the Ann Arbor installation of lamps been that the city has ordered additional equipment and the company is reaping the reward of its far-sighted policy.

Frank A. Mistersky, in speaking of the first tubes used by his company, mentioned the fact that after it was found that these tubes must be kept warm, some of them had had a life of as much as 6,000 hours. Many had lasted 5,000 hours and many more 4,000. Seventy tubes which were expected to last one year, lasted more than two years. As to the saving made, Mr. Mistersky remarked that 867 arc lamps had been replaced by flaming-arc lamps and there had been a saving of $14,000 in the first year. In the station, triple-expansion engines driving direct-current generators were replaced by turbine-driven units.

The first session then adjourned.



THE STEAMSHIP MINNESOTA.

A CONVENTION GROUP.

SECOND SESSION.

The session was opened by J. D. A. Cross, whose paper follows.

THE FUTURE OF ELECTRIC COOKING.

The demand for an electric range which could do cooking in the same time as it is done by a gas stove was taken up by Mr. Cross, and the development and requirements of the electric range briefly followed. There is no doubt that the self-contained cooking utensil is the most economical than a range, but the electric range is compact and is extremely convenient. A special type of range was recently developed by the Cleveland Electric Company, in which are combined a storage heating oven is combined with hot plates and radiant boiler. The oven is kept in the circuit at all times while the plates are put on for a short time while in actual service. This range is being pushed by the Cleveland company. For this as well as other pieces of heating apparatus the housewife should be educated and much can be done in this line by demonstrations. The current may be able to accomplish much more cooking if proper methods are followed. The percolator and chafing dish as well as the table toaster are a practical necessity for modern hotels. The easiest devices to introduce were then taken up in the following order: Toaster, high-temperature devices, such as broilers, and low-temperature devices in which class boilers and stewers fall. The ranges, which were especially mentioned, are available in large sectional units to displace the hotel gas or coal range. Tests made in the United States Navy show a better economy than was obtainable with coal. Thirty-one ranges have been ordered for the navy, and two of these have already been installed. Bake ovens of sixty-four and ninety-six-loaf capacity are also standardized for the Navy. With these an economy of one-fifth of one cent per loaf, with a price of three cents per kilowatt hour would be possible.

Opening the discussion, Mr. Siebley urged the use of larger heating units with their resultant larger income, citing the case of his own company and its success in this line. At Benton Harbor, which Mr. Siebley represented, the company receives an income of $300 per month from enameling ovens.

Answering a question of Mr. Sterling's regarding the electric fireless cooker, Mr. Cross remarked that the General Electric Company did not contemplate putting out fireless cookers, but had manufactured, for some time, a storage cooker of small wattage, which could be left on the line twenty-four hours per day. With such an arrangement a very low rate could be made.

The following paper on the subject of "Incandescent Lamps" was then presented by Mr. Klingman of Cleveland, O.

THE TUNGSTEN INCANDESCENT LAMP.

The paper read by Mr. Klingman took up the history of the development of the incandescent lamp from the introduction of the thread filament by Edison in 1880. Since that time a great number of mineral, vegetable and animal fibers numbering some 6,000 in all were used in investiga-

tions and experiments to obtain a satisfactory incandescent body. The result of these experiments was a quite satisfactory lamp using a thread filament, the manufacture of which was taken up by the Thompson-Houston, Sawyer-Mann, Brush, Westinghouse, Shafer and Edison companies. The author also took up the method of manufacture of the bamboo-filament lamp, which was in use until 1891, and the later cellulose-filament lamps. The metalized-filament lamp was first produced in 1906 after a long period of experimental work. A tantalum lamp brought out later had an efficiency of about two watts per candlepower, and operated at a temperature of 2,300 degrees centigrade. Then followed the osmium, mercury-vapor, and finally the Mazda lamp. The Auer or paste method of producing a tungsten filament was described. Wire used in the later drawn-wire Mazda lamps has a tensile strength of from 400,000 to 700,000 pounds per square inch and can stand shocks that were impossible with a paste-filament lamp. Mentioning the important applications of the tungsten lamp, Mr. Klingman spoke of the great strides that have been made in the last two years toward the standardization of voltages, lamps and accessory apparatus. The axle generating system is becoming the adopted standard of generating unit, which combined with an effective regulating system is undoubtedly the best method of generating power for car lighting. The regular voltage for this class of service ranges from twenty-eight to thirty-four volts and fifty-seven to sixty-five volts, tending toward the lower voltage, generally thirty-two. Automobile lighting has possibly advanced a greater percentage in the last year than any other class of lighting. Its field has prompted the design and manufacture of various systems for the generation of electricity and the total output of 1912 model cars for five of the largest automobile manufacturers will be electrically lighted exclusively. It must be added also in this regard that the attitude of the majority of automobile manufacturers is in favor of this system of lighting. The subject of low-voltage sign lighting was also taken up.

In discussing Mr. Klingman's paper, W. J. Trott, of Grand Rapids, spoke of the fear, which was so prevalent among central-station men, that the tungsten lamp would decrease the revenue of the plant. Those who took it up, however, are now enjoying a considerably increased business and are competing actively and successfully with gas lighting. The new drawn-wire filament, especially, is on account of the ruggedness, making great progress. Mr. Trott also suggested the use of recording voltmeters at various points in the line to keep track of the variations of voltage.

J. H. Siebley, of St. Joseph, added that his company began with tungsten lamps in 1908, and at first found its bills considerably reduced. The advertising value was good, however, and at present the business shows a great increase. During the first year of use of tungsten lamps, the company's earnings increased 20.3 per cent, during the second year the increase was 20.6 per cent and in 1910 there was a further growth of 22.5 per cent. The increase for the five months of the present year has been 26.75 per cent.

H. Ai. Chase, of Hart, added that in that city tungsten lamps are now in exclusive use. Mr. Cavanaugh cited a case of an installation made four years ago, in a local drug store. Although these lights had burned every night during that time there was still four of the original lamps in service.

A paper was then read by Howard Pett, of Big Rapids, on the "Grounding of Secondaries and Periodical Inspection of Transformers."

THE GROUNDING OF SECONDARIES.

The extent to which water power was available in Michigan, the high transmission voltages which had resulted, and the necessity of grounding the secondaries of the transformers on the service lines, formed the basis of Mr. Pett's paper. In this state the voltages have twice been carried beyond the limit of that in use elsewhere, and there has been an increasing demand for protecting the workmen from accidental contact with lines which had, through breakdown of transformer insulation, become impressed with a high voltage. The author dealt thoroughly with the best method of obtaining grounds and mentioned tests of ground moisture which had been made for the purpose of ascertaining how deep a ground should be put and what method of grounding should be used. The standard form of ground connection used by the Grand Rapids Company is composed of a piece of heavy cable about thirty-six inches long. To the center of this piece of cable a piece of No. 6 weather-proof wire is soldered for a ground lead. The strands of the cable are then separated and spread out and buried in the ground at the foot of the pole to a depth of seven or eight feet. Charcoal powdered and placed around this is sometimes used but the benefits derived from its use are doubtful. All lighting and power transformers on the Grand Rapids-Muskegon Power Company's lines are fused on the primary side. The fuses and fuse boxes are made up in the company's shop. The fuse consists of standard fuse wire enclosed in a three-eighths-inch glass tube twelve inches long equipped with brass chips on the end. These chips fit into brass terminals, mounted on standard porcelain insulators. This is inclosed in a box screwed to the cross arm. The box is made of seven-eighths-inch pine well filled and fitted with entrance bushings for the wires. One side of the box is hinged to allow of the renewing of the fuses. Tests are made monthly on transformer oil.

R. M. Hemphill, in discussion, called attention to the report of the National Electric Light Association on grounding. It was stated in that report that the grounding of secondaries should be made compulsory.

THIRD SESSION.

In order to utilize the available time to best advantage a meeting was held on Tuesday evening, this being opened by a paper read by L. B. Andrus of South Bend. An abstract of Mr. Andrus' paper follows:

CHANGING THREE-PHASE TO TWO AND SINGLE-PHASE CURRENT.

Mr. Andrus' paper consisted of comments on the changing of a 2,300-volt two-phase four-wire distribution system to a three-phase four-wire distribution system, being fed from the same three-phase high-tension line with step-down transformers, also having one or more generators on the step-down side as auxiliary to the high-tension line in case of shortage or entire absence of power from the high-tension line. The paper covered the main points at issue from a central-station standpoint. The connections made were explained in detail with the assistance of numerous diagrams.

A question as to whether the changes had been made in the most economical way was answered by Mr. Cavanaugh, who called attention to the fact that time was a considerable factor in this change, and that in the case in point all work had to be done rapidly and with stock transformers only.

The following paper on modern accounting was then read by John H. Siebley, of St. Joseph:

MODERN ACCOUNTING.

After following the history of accounting from its earliest stages. Mr. Siebley outlined the various systems of keeping the financial records of a central station. He recommended that methods be standardized at a convention of auditors of the various companies operating in the state. Nearly all information which is recorded in a modern plant comes from outside the office, in the power house, in the meter department, in the sales department, or when there is a man or a machine at work, and it comes, most of it from the heads of departments. It will always be found that the information which reaches the auditor's office will be, in a measure, colored by the relations existing between the head of the originating department, and the auditor. Colored information makes unreliable records, so it is only under cordial relations that the accounts possess their maximum value. The author particularly impressed upon his hearers the value of high-grade men in the auditing department.

The evening session closed with the reading of the report of the Accounting Committee by Thomas Hinks.

REPORT OF COMMITTEE ON UNIFORM ACCOUNTING.

In the introductory remarks preceding the reading of the report, attention was directed to the fact that not enough consideration had been given to the subject of uniform accounting, perhaps through a fear that such a system might entail additional expense. The method evolved by the committee was designed to display logically the exact distinction between income, expense, maintenance, and property accounts, and to give a thorough and uniform account of all transactions. The system recommended is believed to be adaptable to the use of both large and small companies. The average company can well afford to use all of the accounts enumerated. The large companies may subdivide the accounts so as to go into the greatest detail. The smallest company can at least keep the eight or ten main accounts. The committee has adopted for its guidance in arranging the report, the system of accounts used by the Detroit Edison Company. This latter follows closely the sys-

tems approved by the Wisconsin Railroad Commission and the National Electric Light Association. The committee recommends the adoption of the system of accounting submitted and recommends also that a committee be appointed to prepare forms for use with the system as adopted.

FOURTH SESSION.

The first paper of the session on the subject, "Heat Conservation as Applied to Electric Cooking and Baking" was read by Herbert Silvester in the absence of Sebring Phelps, author of the paper, and inventor and designer of the electric fireless cookstove. Mr. Phelps' paper is here given in abstracted form:

CONSERVATION OF HEAT.

By heat conservation, Mr. Phelps explained that he meant, not necessarily the act of retaining a certain temperature of heated air in an air-tight, heat-retaining case, but the application of heat in such a way as to secure the best cooking effect by the lowest current consumption and the lowest maximum demand. Two experiments were taken up in full, one of the cooking of a six-pound roast, which was cooked at a cost of three cents with power at six cents per kilowatt-hour. The maximum demand was 500 watts. A bread-baking experiment which was also described, resulted in the cooking of four loaves weighing two-and-one-half pounds each, at a cost of about three cents with power at six cents per kilowatt-hour.

The author also took up the relation of central stations to heating appliances, making the statement that one of the most grievous troubles was the lack of proper co-operation on the part of many central station managers.

The paragraph relating to the lack of co-operation on the part of the central station was commented upon by Mr. Hemphill, who stated that he had not, in his experience, found this to be the case. On the contrary many companies are giving much time and expending much money in the development of the heating business.

A paper on "Governmental Control of Electric Light & Power Companies in Michigan," which was prepared by Humphrey S. Gray, was, in his absence, read by J. B. Siebley.

GOVERNMENTAL CONTROL OF MICHIGAN UTILITIES.

Mr. Gray listed the regulations which applied, in the State of Michigan to the lighting, power, and street-railway companies. One section of the law which was read provides that no person, firm or partnership, association or corporation operating a public utility shall have the right to use of the highways, streets, alleys or other public places of any city, village or township, for wires, poles, pipes, tracks or conduits, without the consent of the duly constituted authorities of such city, village or township; not to transact a local business therein without first obtaining a franchise therefor from such city, village or township. The constitution thus fixes the necessity of a franchise and then provides that a franchise cannot be granted without a vote of the electors. This renders these utilities wholly subject to the will of the municipal board, which may refuse to grant permission at all, or name any conditions for their consent, and then the whole city or township must vote even if only one highway in a remote corner is crossed or used. This the author held to be extreme.

F. D. Spencer, of Cheboygan, then read the paper which, in part, follows:

MUNICIPAL PUMPING.

Through several reasons, chief of which seems to be the trouble of impressing municipalities with the advantages of electric pumping, Mr. Spencer stated that this branch had not received proper attention. A pumping load is very uesirable in that it helps to even up the underload condition of boilers, engines and dynamos, thus decreasing the coal cost per kilowatt-hour output when the station is operated nearer to the full load point. Further than this there is the possible great saving in labor offered by the remote control of electric driven equipment and the use of synchronous motors to improve the power factor of an alternating-current circuit. With these conditions assured we should not lose heart at the repeated failures to interest the municipality, but keep everlastingly at it until the contract is secured. If the pumping is performed with direct-acting deep-well pumps or direct-acting pressure pumps which make uneconomical use of the steam expansion large savings may be made by using electric-motor drives. As a rule the small city and village pumping stations feed into an elevated tank from which water is supplied to the mains by gravity. A system of this kind is almost ideal for the central station to serve since the pumping may be done at off peak hours and at times of lightest load conditions. Two systems were considered; first, the plant pumping from a river or shallow well direct into the main, and, second, the plant pumping from a deep well into reservoir and from the reservoir into the main.

Mr. Champion, of Holland, called particular attention to the excellent load which was furnished, at his station, by a 150-horsepower motor driving a triplex pump. This pump was in operation seventeen or eighteen hours per day, pumping against a 150-foot head. The pump is operated until the standpipe gives a pressure of about sixty pounds to the square inch, and on the pressure falling to forty pounds, the pump is again put in operation. He found that a power consumption of about 860 watt-hours was required per gallon of water pumped. Mr. Cavanaugh had found that about one kilowatt-hour was required for each gallon.

The session was concludede by a paper on the "Promotion of Business in Small Towns," by George D. Slaymaker.

PROMOTION OF BUSINESS IN SMALL TOWNS.

As most companies in the state are doing business in towns of less than 5,000 inhabitants, Mr. Slaymaker's paper was of a very general interest. The problem is essentially different from that of the city plant, for the company is doing business in a semi-rural community where the inmoving of a new family marks an epoch; where the population has a large proportion of farmers "who have moved into town to die" and small merchants doing a hand-to-mouth business; where an installation of twenty sixteen-candlepower lamps is considered the height of luxury and where a small motor is rare or else unknown. A company operating in such a town, inevitably reaches the point where it can see no more business ahead. All available residences and stores are lighted by electricity and there is no chance for a power load because there are no industries. In such a case, we are confronted by the alternative of standing still, of else of making a new market for our commodity. The former alternative is untenable. Then how to accomplish the latter, the procuring of new business is the basis of the problem. In Rochester, Mich., the plant not only secures new business, but makes new business In this plant all the employees are solicitors and the company depends on low rates and universally fair treatment to do the rest.

EXECUTIVE SESSION.

At the executive session held on Thursday morning the report of the nominating committee was read and the following officers elected for the coming year: President, R. M. Hemphill, of Ann Arbor; vice-president, James De Young, of Owosso; secretary, Herbert Silvester, of Detroit.

The question of making the Association a geographic section of the National Electric Light Association was brought up and a committee appointed to consider the matter. The committee is as follows: John A. Cavanaugh, Ora S. Wood, H. A. Fee, F. B. Spencer and H. C. Sterling. This committee will meet and the matter will be taken up sometime in the near future.

ENTERTAINMENT.

Special entertainment features were hardly necessary, as amusement was furnished by the diversions common to extended water voyages. Card games were arranged between the ladies, and while not in session all aboard found ample subject for conversation in the ever changing scene.

Leaving Chicago at noon Monday, June 19, the boat proceeded to Grand Haven, where the members of the Association were taken aboard. The first stop was made at Sault Ste. Marie, where the boat landed the following morning. Here automobile rides were arranged for the ladies, while the men found much of interest in viewing the two cities and the Soo locks. Several parties also shot the rapids.

Leaving the Soo Wednesday noon the boat proceeded to Mackinac Island, arriving there early in the evening. A two-hour stop was made and parties were made up to view the old fort and the natural beauties of the island. On account of these stops the idea of landing at St. Joseph was abandoned, and the party was set ashore at three o'clock June 22, at Grand Haven.

THE CANADIAN ELECTRICAL ASSOCIATION.

ANNUAL CONVENTION AT NIAGARA FALLS.

The twenty-first annual convention of the Canadian Electrical Association was held at Niagara Falls, Ontario, on June 21, 22 and 23, and proved a great success. The meetings were held in the Convetnion Hall of the Clifton House, from which the members could see the world-famous water fall, which today is producing so much electrical energy.

At ten o'clock on Wednesday morning the president of the Association, A. A. Dion, called the meeting to order and introduced O. E. Dores, the mayor of the city, who, with his usual geniality, extended to the members a hearty welcome, trusting they would avail themselves of the opportunities placed before them, not only of viewing the wonderful works of nature, but also the great power plants and other points of interest. President Dion, replying, thanked the mayor for his kindly words of greeting, and expressed his pleasure at being able to meet at least once a year the brightest men in the industry.

With the object of spreading the influence and usefulness of the Canadian Electrical Association, the Managing Committee had at first decided to hold this year's meeting in Winnipeg, but conditions had been such that the visit to that city had to be postponed until some future time. President Dion referred to the affiliation of the Canadian Electrical Association with the National Electric Light Association, which he thought could not fail to be of the greatest benefit, not only to the individuals, but to the companies which they represented; that the circulation of the literature more largely would be of very great value; and bespoke the loyal support of every member in the interests of all. He referred also to the formation of provincial committees which had taken place during the past year, and he felt sure this would result in bringing many new members into the Association. He advocated forming the past presidents into an advisory board which could deal with matters of public policy.

The secretary-treasurer then gave his report, showing the Association in a prosperous condition, with an increasing membership; and gave an outline of the negotiations which had been carried on with the Canadian Government with respect to having postage stamps printed in rolls for the convenience of companies having a large mailing list.

The election of J. J. Wright, a past president, as a life member, was greeted with hearty applause.

The next order of business was the reading of a paper by E. Little, operating superintendent of the Kaministiquia Power Company, Fort William, Ontario, entitled, "Operating Safeguards." In the absence of the author, the paper was read by R. F. Pack.

OPERATING SAFEGUARDS.

Mr. Little pointed out that although the subject was a large one, it might be divided into two headings: (1) safeguards insuring the continuity of service; and (2) safeguarding life and property. He emphasized the importance of governors and voltage regulators and their working in perfect unison. Oil switches and circuit-breakers were now in general use, but periodical inspection should be made on account of possible leakage of oil or the working loose of rods. He went on to mention a certain type of switch now being used by some European engineers which had an intermediate set of contacts connected to a suitable resistance over which the moving contacts passed. Each power plant had, he said, its own local conditions which had to be considered. In certain localities lightning arresters were very necessary. Where aluminum cells were used great care should be taken in their erection; the regular charging of cells is very important. In sparsely settled districts malicious interference is sometimes met with, and, if possible, an example should be made of such an offender, care being taken not to give the impression that the company is vindictive. A large number of accidents were, he thought, caused by absent-mindedness, and operators should be trained to concentrate their attention. Reports of trouble should be kept on file and operators should study all conditions. Drill for first aid should be given, and physicians, school teachers, etc., should be asked to cooperate in teaching methods of giving first aid.

This paper called forth a general discussion by Messrs. Martin, P. H. Kemble, R. F. Pack, I. H. Wright, Glenn Marston, and others. Mr. Marston thought the important thing to impress upon the minds of the public is to be careful, although if properly conducted the use of electric current was quite safe. Mr. Dion contended that there was nothing so effective as practical demonstration in educating people in giving first aid to one who has received an electric shock.

President Dion then called upon Glenn Marston, of Chicago, to read his paper, entitled "The Advantages of Publicity to the Central-Station Industry."

CENTRAL-STATION PUBLICITY.

This paper outlined, shortly, the best methods of getting before the public in a favorable light. Advertising fell broadly into two classes, paid advertisements and free reading notices. Free reading space was gladly given for some news of interest concerning a company. The writer was unalterably opposed to paying for reading space. As instances of what might be put in these articles, he mentioned: "How Electric Fans Prevent Typhoid"; "The Effect of Window-Lighting on a City's Growth"; "The Police Value of Light"; etc. Paid advertising is just as important as free, and he had unbounded faith in display advertising. Publicity could be made an effective agent in leveling the load curve. Advertising should tell a story. A paragraph or two on the unique features of electric ironing, for instance, will attract more attention than low price.

The paper provoked a lively discussion. President Dion said he had heard that some of the large companies rather pinned their faith to monthly bulletins issued from the company's office.

Mr. Martin thought the writer might have spoken more at length on some other advertising mediums, such as bill posters, window posters, electric exhibitions, etc. In a friend's house he had once seen an electric light bill come in which was thought to be excessive, where along with the bill there were circulars recommending various devices, and it seemed to him the effect of it was that his friend did not use the devices. He thought the company should tell its own story in the way it wanted it told, giving the reasons why it should have a lighting contract, and it would work out to its advantage.

I. H. Wright thought that Mr. Marston's remarks would not apply to newspapers in small towns, as the editors were not usually "big" men. President Dion asked if assisting people in wiring their houses was not a good idea, to which Mr. Marston replied that he thought it was. He concluded by saying that all properly conducted publicity was bound to pay, in the future, if not immediately. People did not know enough about electricity and when they did, more current would be used. In answer to a question by R. G. Black, he also thought cartoons were a good medium of advertising.

AFTERNOON SESSION.

On resuming in the afternoon the first business taken up was a paper entitled "Service Protection," by George R. Smith of the New York Edison Company.

SERVICE PROTECTION.

This paper called attention to the fact that the tampering with wires was something which had to be considered; and that in the writer's opinion it was better to remove the temptation out of the way of customers than by apprehending and prosecuting them. The paper outlined several methods of overcoming the difficulty such as sealable cut-outs and fuses; and stated that increased attention was now being given to having meters and similar devices adequately sealed.

It was admitted by those taking part

in the discussion that this had become a very important matter; that as customers became more familiar with electrical appliances they were more prone to tamper with the wires, and devices to prevent this had become a necessity, especially in large cities.

L. V. Webber thought the item of cost was one which should be taken into consideration, and that very good results would be obtained by adopting the system in suspected cases only. In reply Mr. Smith stated that he had learned that in one city, where the devices had been put in, they had resulted in a decrease of fifty per cent of the loss by current being extracted.

It was the consensus of opinion that it was a subject which required careful study and some means ought to be taken to stop a practice which was becoming too common. Mr. Smith also added that a device for the protection of the wiring was very valuable, not only for that purpose, but also for testing the meters.

The next order of business was a paper by C. E. Bowden, auditor of the Toronto Electric Light Company, entitled "General Accounting."

GENERAL ACCOUNTING.

In this paper Mr. Bowden pointed out the importance of central stations ascertaining their true position in all departments; and this could only be done by a proper system of accounting. The problem of scientific management has become a very live subject in the public mind during the past few months, and a new viewpoint or a new philosophy in industrial management had been occasioned. Waste was deplored, as it could benefit no one, and the goal to be reached was its total elimination. The efficiency of a plant should be raised to the highest possible point, and this in turn would produce economy. A classification of accounts was necessary and especially so with electric lighting companies. One of the important factors, he said, was "stores accounting" or the accounting of material. A good idea was to have a card index of each article and to facilitate this the storeroom should be arranged with numbered bins, one kind of material being placed in each bin. The number of the bin and the article should then appear on the ledger sheet or index card, and this loss could be avoided. In cost systems, he said, some large plants were now using the method of ascertaining the cost before the work was undertaken, and this was found to have many advantages. One of the great advantages accruing from a system of accounting was the opportunity it afforded for comparisons, and by studying these comparisons the management could determine whether proper results were being obtained from the work of the various departments. The paper went on to point out the necessity for central stations taking every means possible in order to effect internal economy, confronted as they were on the one hand with increase in cost and on the other with public sentiment which is hostile to increasing rates.

Before discussing the paper the report of the Committee on Uniform Accounting was read by R. F. Pack.

On opening the discussion President Dion referred to the very valuable work done by the Uniform Accounting Committee and hoped that its recommendations would be carried out, as it was very important to know the cost of each factor in the total expenditure. While some thought an elaborate system of accounting a waste of money, companies ran a great risk if they did not know where they stood, and exactly where mistakes were made and losses occurred.

Mr. Bowden should be commended, said Colonel Street, for his comprehensive paper, and he felt sure that the smaller stations could adopt the system he suggested in a form which would certainly be of much benefit to them. It was of the greatest importance, said I. H. Wright, to keep track of the stores, and this part of the paper was indeed worthy of study.

THURSDAY MORNING SESSION.

This being the day of the coronation of King George and Queen Mary of England, and being a general holiday throughout Canada, the large convention hall was crowded to overflowing, contingents coming from Toronto, Hamilton and other places for the day.

The first paper read was one by Wills MacLachlan, of the Trenton Electric & Water Company, Belleville, entitled "Some Notes on Central-Station Management."

CENTRAL-STATION MANAGEMENT.

The paper pointed out how central stations had developed in recent years, and consequently it was necessary for the central-station manager to be a man of parts, or he would find his pathway full of pitfalls. It was necessary to train the staff so they might be efficient in their own particular lines, and the holding of staff meetings was a very good thing. Meter readers should be trained not to cause any more inconvenience when entering a house than absolutely necessary, and the reader should inquire after the details of the operation. In laying out systems, the extensions should be considered either on the tree or loop system. The great object for every central station, the author said, was the getting of new business, and in this regard it was necessary to make a careful study of the situation. A central-station man was by his position, Mr. MacLachlan thought, especially adapted to give advice and suggestions with respect to a city's health, beauty, safety and prosperity, and he should keep in close touch with the public.

Mr. Martin in commenting on the paper said he thought a company could afford to pay $1,500 a year to a man whose business it was to go around and talk with customers. Colonel Street took exception to the statement in the paper that the meter reader should take up his time inquiring about the details of the service; he thought the less he said the better, as unless he was specially adapted for that class of work he would cause trouble. In reply Mr. MacLachlan said in this respect he was referring more to small towns.

A paper was then read by G. B. McNabb, of Montreal, on "The Relations of Public-Utility Corporations with the Public."

RELATIONS WITH THE PUBLIC.

The paper pointed out that the public liked courteous treatment from everyone in the company with whom they came in contact, and it was worth while to cultivate the good will of the community; a consumer who made a complaint was entitled to have his complaint looked into thoroughly, and if there was found to be anything wrong it should be made right immediately. Too much attention could not be paid to the so-called "Crank," as by proper handling he could be turned into a warm friend of the company. It should be seen to that orders for service were promptly attended to. The paper went on to say that no one department was responsible for the success of a company, but all must work in harmony to this end. Mr. McNabb thought discrimination among customers of the same class was sure to cause trouble, and companies should try to get a schedule of rates which would be uniform.

As Mr. McNabb's paper had covered the ground very thoroughly Colonel Street though, there was very little to add, except to say that the telephone was really the cause of more annoyance to the public than lighting.

At this point President Dion called upon John F. Gilchrist, the president of the National Electric Light Association, to address the convention. Mr. Gilchrist was greeted with a hearty round of applause. He said in the present age when the electrical business was so young, and when there were practically no hand books on the subject right up to date, that it was expedient that meetings should be held where topics on recent developments could be discussed, and he thought it was the business of all electrical men in North America to get together and compare ideas and learn of each other. It was, he said, a great pleasure for him to meet so many friends in the electrical business.

The next paper taken up was one by Parker H. Kemble, of the Toronto Electric Light Company, entitled "New-Business Getting."

NEW-BUSINESS GETTING.

Business, he said, could be divided into two classes,—profitable and unprofitable, and a company should discriminate in soliciting new business in this regard. Where power was bought on a maximum-demand basis, the writer, said, any business affecting the peak load should be carefully examined. The work of the salesman should be judged by the increase or decrease of net revenue in the districts covered by the men as compared with previous records. As competition became more keen, or the

supervision of public services became more strict, success was dependent on small details. New business, he said, was the life-blood in the progress of a central station, but it was wise to take into consideration whether or not it was best to go after all classes of customers. He thought a careful selection should be made. A salesman should study the conditions in his territory, as it was a great mistake to solicit a man to put in electric service in an impossible place. It was also a mistake to unthinkingly exaggerate in order to "land" a customer. The writer pointed out, however, that there should be no let-up in the campaign for new business, but that efforts should be concentrated along lines where there was the greatest profit.

In reply to a question by Colonel Street as to how agents should be paid, Mr. Kemble said with the proper man a salary was the ideal way, but under present conditions a straight salary, with possibly a substantial bonus at the end of the year, if the business warranted it, was the best method. The writer also thought, with Mr. Marston, that it was a wise thing for the salesmen to study such points as diversity factor and load curves, as a knowledge of those would assist materially in his work.

The next business was the presenting of the report of the Joint Committee on Meters and Meter Inspection. L. V. Webber, presented the report. The report gave a summary of what had been accomplished during the past year, particularly the negotiations with the Canadian Government, which had resulted in the fee for meter inspection being reduced from seventy-five cents to sixty cents.

In connection with the report Mr. Lamb, of the Government Inspection office, addressed the meeting on "The Canadian System of Governmental Control of Electric Light and Power Service." P. T. Ravies, of Montreal, also gave a short address on "Metering Under Two-Rate Contracts." The morning session concluded with a papare by Ralph Beman, of the National Electric Lamp Association, entitled "The Incandescent Lamp and Its Circuit," which dealt exhaustively with the subject.

The Association luncheon was well attended, the repast being everything that could be desired. After-dinner addresses were delivered by A. Munro Grier, vice-president of the Canadian Niagara Power Company, on "The Coronation," and Samuel Insull, president of the Commonwealth Edison Company, of Chicago, after which the members took electric cars for Chippewa on a sight-seeing tour, which concluded the program for the day.

FRIDAY MORNING SESSION.

An executive session was held Friday morning for the election of officers for the ensuing year. The following were elected: President, A. A. Dion; first vice-president, R. F. Pack; second vice-president, W. L. Bird; secretary-treasurer, T. S. Young. The following were elected as members of the Managing Committee: W. C. Hawkins, A. L. Mudge, C. E. A. Carr, D. H. McDougall, F. A. Chisholm, L. V. Webber, W. Phillips, J. H. Larmouth, J. S. Norris, I. H. Wright, J. W. Purcell, R. H. Sparling, J. W. Crosby and R. B. McDonagh

The regular session then resumed its sitting, the first business being the reading of a paper by C. F. Scott, of the Westinghouse Electric & Manufacturing Company, on "The Importance of Co-operation Between the Central Stations and the Electric Manufacturers."

CO-OPERATION BETWEEN CENTRAL STATIONS AND MANUFACTURERS.

Mr. Scott, for convenience, divided his paper into three heads, namely "Engineering," "Commercial Engineering" and "Commercial." Good apparatus, well operated, was the engineering basis upon which the whole central-station business rested. Good service could not be expected from badly designed or badly built apparatus. Mr. Scott then went on to point out some ways in which the central station could co-operate with the manufacturer. Standard apparatus should be purchased if it would meet the requirements; conference with the manufacturer by the central station as to best apparatus to use, and so on. On the other hand, the experience of the central-station manager could greatly assist the manufacturer in manufacturing machinery which would give the best results. Conditions were continually changing, and co-operation was very necessary to keep abreast of the times and attain results. In commercial success and prosperity the central station and the manufacturer had much in common, as together they supplied a growing need to the community. Continuity of service was becoming more and more important, and the central station, in fairness to its customers, required the best possible apparatus.

This paper was regarded by those present as a very important one, and Messrs. Black, Kemble, Baker and others took part in the discussion.

A paper was then read by T. F. Kelly, of the Hamilton Electric Light Company, on "Ornamental Street Lighting." The paper gave a comprehensive review of the different street-lighting systems now in use in different parts of the country with regard to standards, globes, etc., and pointed out that it had been thought that street illumination would decrease the window and sign illumination, but this had been found to work out in quite the opposite direction.

Mr. Pratt supplemented Mr. Kelly's paper by giving some figures as to the cost of maintenance and the importance of getting good globes.

The report of the Committee on Standardization of Line Construction was presented by R. G. Black, the chairman, who referred to the valuable work gotten out by the National Electric Light Association, which, he said, was well worth studying. The convention then adjourned till the afternoon.

The first order of business in the afternoon was the reading of a paper by C. E. Allen, of the Westinghouse Electric & Manufacturing Company, entitled "The Importance of the Use of Potential Regulators on Distributing Systems."

POTENTIAL REGULATORS.

This paper pointed out the necessity for regulators, and the demand for them, and gave a résumé of the different makes, and how they had progressed until they had come to their present state of efficiency. Mr. Allen went very fully into the matter of the mechanical construction of the machine. The paper was profusely illustrated and was very much appreciated.

It was pointed out in the discussion that regulation on a circuit tended to give uniform voltage, and in that way affected the quality of the service. If there was an interruption in the service for five minutes, even though the service during the year had been perfect, it was the five minutes that the customer usually looked at, and regulators were therefore of the utmost importance. Mr. McDougall asked if the feature of noise had been eliminated, to which Mr. Allen replied that there was now very little or no noise in the machine itself.

A paper was read by Roderick J. Parke, of Toronto, on "Some Recent Developments in Electric Heating and Cooking Devices."

ELECTRIC HEATING DEVICES.

This was a very interesting paper, giving details of tests applied with gas oven, the non-automatic electric oven, and the automatic electric oven. The great utility of the electric oven was shown by these tests, and with proper adjustment it could be made to operate at a lower cost than gas.

Before the close of the meeting a hearty vote of thanks was given to W. L. Adams, chairman of the Entertainment Committee, for the excellent way he had provided for the entertainment of the members of the Association and friends. Mr. Adams replied that he had been more than repaid by the appreciation shown by the members.

For the entertainment of the members and friends there were provided many attractive diversions.

LETTER TO THE EDITOR.

The Brunots Island Power Plant.

To the Editor:

We notice in your issue of June 17 an article on page 1207 by Hartley M. Phelps, descriptive of the Brunots Island Power Plant of the Pittsburg Railways Company, in which there is an inaccuracy, which we think you will be glad to correct.

On page 1208, in the first column, reference is made to "one 3,000-kilowatt alternating-current generator, direct-connected to a double-flow Curtis steam turbine." As a matter of fact, all of these turbines are Westinghouse-Parsons and not Curtis.

This is no doubt an inadvertence, but inasmuch as it is rather an injustice to the Westinghouse Machine Company, one which we should be glad to see corrected and of which, we have no doubt, you are glad to be informed.

J. C. McQUISTON.

East Pittsburg, Pa., June 20, 1911.

International Electrical Congress at Turin.

A preliminary announcement of the International Congress of the Applications of Electricity to be held at Turin, Italy, from September 10 to 17, 1911, was made in our issue of March 11. The Congress will be divided into the folloing sections:

I. Electrical Machines and Transformers.

II. Electrical Installations and Networks.

III. Instruments, Apparatus and Switching Devices.

IV. Lighting and Heating by Electricity.

V. Electrical Traction and Propulsion.

VI. Telegraphy and Telephony.

VII. Accumulators, Electrochemistry, Electrometallurgy and other Applications.

VIII. Tariffs, Taxation and Legislation in regard to the Distribution of Electrical Energy.

The first and last meetings of the Congress will be general sessions. At the first general session there will be elected an honorary president and a Presidential Board of the Congress, including a president and a number of vice-presidents, a general secretary and two joint-secretaries. Each section will also have its presidential board.

Of the subjects previously announced for discussion by invited speakers the following have been already assigned:

"Electrical and Mechanical Characteristics of Modern Electric Generators, with special reference to Very-high-speed Machines," P. Behn-Eschenburg, Switzerland.

"Present State of Technical Progress in the Manufacture of Stationary and Traction Batteries," Dr. Beckmann, Germany.

"The Selection of the Transmission and Distributing Pressure and the Design of Switchboards and Substations in Large Electrical Installations, Taking into Account Both Economy in First Cost and Continuity of Service," Philip Torchio, United States.

"Underground High-tension Networks in Metallic Connection with Overhead Lines," J. Grosselin, France.

"Present State of Research in Reference to Abnormal Rises in Pressure and Means of Their Prevention and Protection of the System," G. Faccioli, United States.

"Construction and Use of Automatic Circuit-breakers," E. Ragonot, France.

"Converters, Rectifiers and Motor-Generators," Silvanus P. Thompson, England.

"The Problem of Frequency Transformation," P. Bunet, France.

"Three-phase Variable-speed Motors, with Special Reference to Rolling Mills and Paper Mills," C. Sarli, Germany.

"Technical and Economic Influence on the Lighting Industry of the New Metallic-filament Lamp and of the Metallized-carbon Lamp," D. Wedding, Germany.

"High-tension Continuous-current Traction Versus Monophase Traction on Suburban Lines," F. J. Sprague, United States.

"Overhead Line Construction for Electric Railways," Gustave L'Hoest, Belgium.

"Direct Production of Steel from Ores by Means of the Electric Furnace," Remo Catani, Italy.

"Sterilization of Water by Processes Employing Electricity," Dr. Erlwein, Germany.

"Electricity Meters with Special Reference to Different Kind of Loads," C. H. Sharp, United States, and A. Durand, France.

"Government Control of Meters," A. Denzler, Switzerland.

"Rational Methods of Commercial Measurement of Electric Power," G. G. Ponti, Italy.

"The Problem of Increasing the Load-factor in Central Stations," G. Sartori, Austria.

"Application of Electricity to Submarine Boats," Agostino Bezzi, Italy.

"Long-distance Wire Telephony," F. B. Jewett, United States.

"Wireless Telephony," Valdemar Poulsen, Denmark.

"Automatic Telephone Exchanges as a Means of Economy and Improvement in Telephonic Communication in Large Cities," H. Milon, France.

"Research on Secrecy in Wireless Telegraphy," P. O. Pedersen, Denmark.

"Present and Future Development of Electric Heating," C. A. Rossender, Sweden.

"Comparative Study of the Direct and Indirect Methods of Taxing Electricity in Different Countries," Mario Bonghi, Italy, and Dr. Frey, Switzerland.

"Government Regulations in Reference to the Electric Transmission of Power," E. C. Ericson, Sweden, and H. Schreiber, Austria.

"Distribution of Electric Power for Agricultural Purposes," Mr. Leclerc, France.

"The Various Systems of Multiplex Telegraphy," W. A. J. O'Meara, England.

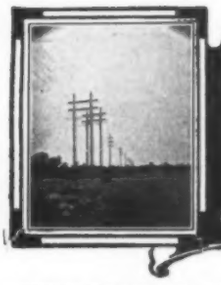
The fee for membership in the Congress is 25 lire ($5.00). Applications should be accompanied by the subscription and should be sent as soon as possible, addressed "Congresso di Elettricita Politecnico, Torino, Italy." Upon receipt, the secretary of the Executive Committee will forward the card of membership, and any other information that may be desired.

Members of the Congress will be entitled to receive copies of the *Transactions*. Papers will be printed in English, French, German or Italian as presented, but unless in French they must be accompanied by an abstract in French.

A meeting of the International Electrotechnical Commission will be held at Turin during the same week in which the Congress is in session.

Copper Prices Rising.

The highest price touched by copper in the current upward movement was 12.8 cents a pound and producers firmly believe that the prices will rise to 13.0 cents in the next two or three weeks.



CENTRAL-STATION PRACTICE

Transmission—Interior Wiring.

DEVELOPMENT OF THE MODERN CENTRAL STATION.[1]

BY CHARLES PROTEUS STEINMETZ.

The predecessor of the huge modern central station is the Edison direct-current three-wire station, which was developed twenty years ago. By a system of feeders and mains, direct current was distributed at 220 volts from a station located at the center of power demand. When the limit of economical distribution from a single station was reached, additional stations were built, and all the stations connected by tie-lines.

Characteristic of these stations were the good voltage regulation, incident to the system of feeders and mains; the high economy, resulting from the parallel operation of all the stations and the consequent reduction of light-load losses to a minimum, and the high reliability of service.

The most serious disadvantage of the direct-current three-wire generating station was the limited distance to which power could be transmitted economically at 220 volts. This limited the use of the system to densely populated districts, as the interiors of large cities, where within the economic radius of 220-volt distribution a load for a generating station of economical size could be found. It also did not permit the best economy of operation, as it required the location of the generating stations in the interior of the cities.

The limitations in the distance of transmissions were soon overcome, and electric power made generally available, by the alternating-current system. As it was first developed, as the single-phase high-frequency system with individual transformers at the customers' premises, it had the fatal defect of large all-day losses in the transformers, and as a result, most of these early alternating-current stations were not an economical success. The alternating-current system became economically feasible only by the introduction of the three-wire-secondary mains, fed from large transformers by primary feeders, that is, the main features of the Edison feeder and main system, from which the modern alternating-current system differs only by the substitution of high-tension feeder and transformer, for the low-tension feeder of the direct-current system, and by the addition of a fourth wire or other method (as separate feeders) to take care of power distribution to motors.

The final power supply to the customers, for lighting or other domestic service, is now generally from a three-wire 220-volt main, by direct current in the interior of large cities, and by alternating-current in less densely populated districts. The characteristics which make the direct-current systems suited for more concentrated, the alternating-current system for less concentrated demands, are:

Reactive drop and magnetic screening are absent with direct current, and large conductors can thus be used, carrying larger currents than are economical with alternating distribution. A greater density of load can thereby be taken care of, larger power supplied over each feeder, and voltage regulation at every feeding point in the mains thus becomes economically feasible. The mains, tied together, exchange power between feeders, and thereby equalize the voltage. Storage-battery reserve is conveniently feasible, with its great increase in the service reliability.

With alternating-current supply, 2,200-volt high-tension feeders can be used, and a much larger territory thereby supplied from one station. Much lower voltage drops are feasible in the high-tension alternating-current feeders, than in the low-tension direct-current feeders, and several transformers with their secondary mains can thus be supplied, with fair regulation, from the same primary feeder, and this allows the installation of small mains of limited extent. The secondary mains may be sectionalized without serious disadvantage in regulation. The high efficiency of the modern transformer permits economical power supply in districts which can not be reached by direct current, as the load is so scattered that only a moderate amount of power is accessible to each main, and sufficient load for the economical operation of a converter substation could not be found within the economical radius of such a station.

The economic disadvantage of the location of a number of direct-current generating stations in the interior of large cities led to their replacement by converter substations, which receive their power from a large three-phase generating station, usually at twenty-five cycles. Thus originated the present system of monster three-phase power-generating stations. Reliability insurance against a breakdown in the generating station led to the subdivision of the power generation in two or more main generating stations, and so we see now in operation in this country huge generating stations, co-operating with each other and with smaller outlying stations, very similar in principle, though vastly greater in magnitude, than the direct-current three-wire generating stations of fifteen years ago.

Comparing the modern system of high-voltage three-phase generating stations, which supply power to a large city and almost to a state, with the system of low-voltage direct-current generating stations of old, we find, besides the vastly greater amount of power of the modern system, and correspondingly greater destructiveness of the power when beyond control, two essential differences:

a. The alternating nature of the power involves in the parallel operation of the generating stations, as required by economy and reliability, the problem of synchronizing, which did not exist with the direct-current stations.

b. While in the direct-current system the power, which could be developed at any point in the system, was limited by the resistance of feeders and mains, and the limited power of the generators, and

1 A paper (slightly condensed) that was presented at the twenty-eighth annual convention of the American Institute of Electrical Engineers, Chicago, June 27.

an accident anywhere in the system could not seriously involve the entire system, but remained essentially local in character, in the present system the maximum power is available practically everywhere, and an accident or disturbance may be felt over the entire system. That is, the safety resulting from the locally limited power, and corresponding reliability, of the direct-current system, is not inherent in the modern high-power and high-voltage alternating system and before the operation of the present huge systems can be as safe and as reliable as that of the low-tension direct-current systems was, means must be found to limit the power which can be developed in case of accident anywhere in the system, to a safe value, that is a value which would not seriously affect or endanger the operation of the system.

The safety of the low-tension direct-current system against general disturbances caused by a local accident, such as a short circuit, was the result of the relatively high resistance of circuits; it was, however, paid for by a lower efficiency of distribution, resulting from the losses in the line, such as are no longer permissible in our modern large systems, and if permissible, would not be feasible, as the distribution cables could not dissipate the power without self-destruction. However, due to the alternating nature of the power, voltage can be consumed in the modern systems by reactance, and the current limited thereby, without corresponding loss of power; and to make our modern high-voltage high-power systems as safe against local accidents, as were the low-tension direct-current systems, power-limiting reactances must in the former take the place of the resistance of lines, feeders and mains of the latter system.

The industry has been slow to realize the importance of reactance in giving safety and corresponding reliability to high-power generating systems. The reason was a prejudice against reactances, which had survived from the early days of the single-phase high-frequency systems, in which the reactance in generators, lines and transformers had been the enemy which spoiled the desired voltage regulation. We are just beginning to realize now, that in the huge systems which use a large part of their power by synchronous machines, as converters, frequency-changers, etc., reactance is not an enemy to regulation, but affords the most effective means of voltage regulation by phase control.

A considerable amount of reactance is necessary for safety, to limit the possible local concentration of power, and for voltage regulation in systems containing synchronous machines, and also for the stability of the latter, as the parallel operation of synchronous machines, whether generators, motors or converters, is possible only if the circuit between the machines contains considerable reactance.

In a station or group of stations of 100 to 200 megawatts generator capacity in high-speed turbo-alternators—and there are a number of such stations now in existence—with a momentary short-circuit current of thirty to forty times full-load current, the maximum current which could momentarily appear at a short circuit on the busbars would correspond to form three million to eight million kilowatts. When opening such a short-circuit, the power at the opening break must pass from zero at short circuit to zero at open circuit, over the maximum momentary output of the generator, which is one-half the product of short-circuit current and open-circuit voltage, or from one and one-half to four million kilowatts. It is obvious that no switching mechanism can be designed which can always be relied upon to open such power, and which at the same time is sufficiently small and reasonable in cost, to employ hundreds of them in the system, on the generators, feeders, etc. Hence the insertion of power-limiting reactance in generators, busbars, etc., becomes necessary for the safety of the system.

The low-tension direct-current generators of old probably gave a momentary short-circuit current of three to five times full-load current, and at permanent short circuit lost their excitation. The modern high-efficiency turbo-alternator gives from three to five times full-load current on permanent short circuit, but nearly ten times as much momentarily. While the permanent short-circuit current is within safe limits of the mechanical and electrical strength of modern apparatus, the momentary short-circuit current is not, but, allowing for the advance in the art of machine design since the days of the low-tension direct-current machine, a momentary short-circuit current of ten to twelve times full-load current would be within safe limits. This means increasing the self-inductive reactance of the generator to eight to ten per cent. It can either be done by the insertion of external reactance, preferably in the phase leads, or by the design of the generator, or by both. Internal reactance of the generator of the required amount interferes with economical design, and has the disadvantage of offering no protection in case of an internal short circuit which eliminates the generator reactance. The preferable method thus is to give the generator a reasonably high internal reactance (three to five per cent) and insert additional reactance in the phase leads, of four to six per cent[2]. Where step-up transformers or auto-transformers are used, they can be designed to afford the required external reactance.

Even when limiting the momentary short-circuit current of the generators to ten times full-load current, with the parallel operation of a system of several hundred megawatts generator capacity, the momentary short-circuit power would still approach millions of kilowatts. It therefore becomes necessary in these large systems, either to operate the system in a number of separate sections, or to sectionalize the busbars by power limiting reactances.

The former is frequently done, but appears to me a temporary expedient only, and economically impracticable as a permanent condition of operation. When limiting the generator capacity per section to a maximum of 60 megawatts, three or four sections would be required in some of the existing systems. As this means a partially loaded generator in every section, a larger total generator capacity is required, and a lower economy of operation results, than with parallel operation of the entire system. Furthermore, reliability would require to supply every substation from several sections, and this would necessitate to sectionalize also every substation on the alternating side, and would thereby lower the economy of the use of feeders and substations. The necessity of providing means of throwing substation apparatus from one section to another section, in case of accident to one section, complicates the method of control and introduces the danger of accidentally connecting together in the substation feeders com-

2 These power-limiting reactances must maintain their reactance at short circuit. Thus, if iron is used in them, the densities must be so low that saturation is not reached with the short-circuit current. With a four to six-per-cent reactance, this limits the iron density to B=500 to 1,000, and as such low densities can far more economically be produced in air, the power-limiting reactances are ironless reactances.

ing from different sections and out of synchronism with each other, with the result of a short circuit between two sections. As the complication of control would usually make it impracticable to carry feeders from more than two sections into a substation, the reliability of service would be lower than in parallel operation, when important substations could receive power from three or more power houses. The loss of economy and of reliability, and the complication of control of the system increase so rapidly with the increasing number of separate sections that it appears to me, that the only feasible method which permits unlimited extension of the system without any increase of danger and

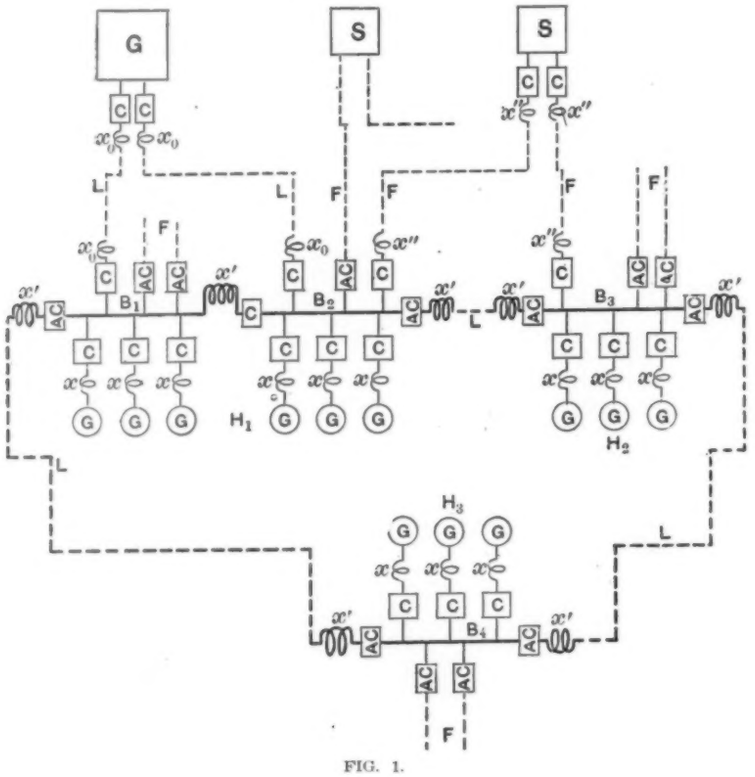


FIG. 1.

complication, is the parallel operation of the entire system, on a single ring bus, which is divided into sections by power-limiting busbar reactances.

These reactances must be large enough to limit the power which can flow over them, so that in case of a short circuit on one section, the adjoining busbar sections are only moderately affected, the further busbar sections not affected at all; at the same time, the reactances must be sufficiently low and of sufficient capacity, so that any amount of current, which during a change of load a busbar section may draw from the adjoining busbar section, can be safely transmitted over the reactance without any voltage drop, by a slight phase displacement between the adjoining busbar sections. With a capacity of fifty to sixty megawatts per section, a permanent carrying capacity of each busbar reactance, of two megavolt-amperes, at fifteen-degree phase displacement, and a power limit, in case of a short circuit on one section and full voltage on the adjoining section, of forty megavolt-amperes appears at present the best compromise. The ring bus, into which all the generators G of the system feed, would then comprise the busbars B of the various power houses, H_1, H_2 ..., and the tie-lines L between the power houses, as indicated diagrammatically in Fig. 1, in which x denotes the power-limiting reactances in the generator leads, x' the power-limiting busbar reactances, F the feeders which issue from the busbar section, and C denotes the non-automatic, A C the automatic circuit-breakers in the system.

We come now to the consideration of the feeders which issue from the generator busbars. In the low tension direct-current system, the effect of a short circuit in a feeder—if not extremely close to a generating station—was limited by the resistance of the feeder. With the modern high-power alternating system, the feeder resistances are very low, and a short circuit in a feeder is almost a short circuit on the busbar. While generator reactances and busbar reactances greatly limit such a short circuit, there still remains the disadvantage, that nothing limits the power which is available locally on a feeder, below that available on the busbar to which the feeder connects, and in this respect the modern system is inferior to the old low-tension direct-current system. The safest method would be to limit the available short-circuit power of every feeder by reactances at either end of the feeder, in the generating station and in the substation S, as indicated by x'' in Fig. 1. This method, which would make the modern high-power system as safe as the former low-tension direct-current system, has not yet been considered, since unfortunately the development of the alternating part of the present system has started from the experience of the small alternating systems of old and not from that of the low-tension direct-current system, and in the former, the

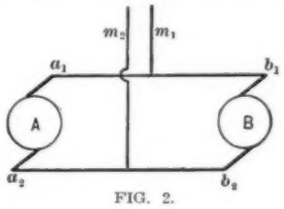


FIG. 2.

limited power of the generating system, combined with the relatively high reactance of the overhead feeders, made power-limiting reactances in the feeders unnecessary. Instead of limiting the power, automatic circuit-breakers are provided in the feeders, as indicated by A C in Fig. 1, which instantaneously cut off the feeder in case of short circuit. This method has been very successful, and with the limitation of power by the reactances in busbars and generators, appears sufficiently safe, but still has the disadvantage of momentarily exposing the busbar section and the feeder switches to the shock of short circuit in case of a failure of the feeder, and it may thus well be considered whether a safer way of operation would not result from limiting the power of the feeders by reactances.

In the parallel operation of the individual generators, and the entire generating station of the modern high-voltage alternating-current system, a problem is involved, which did not exist in the direct-current system, *viz.*, synchronizing.

If two machines, *A* and *B* in Fig. 2 (whether generators, synchronous motors, converters or frequency changers), shall run in synchronism, the constants of the circuit between the two machines, $a_2\ a_1\ b_1\ b_2$, must be such that any phase displacement (that is, position displacement) of the two machines causes a current to flow between the machines, which accelerates the lagging, retards the leading machine, irrespective whether in addition to exchange or cross current between the machines, the machines also send out current, or receive current from the outside, at $m_1\ m_2$. If the two machines are exactly in step, in the local circuit $a_2\ a_1\ b_1\ b_2$, the voltages of the two machines are in opposition, as shown by *a* and *b* in Fig. 3. Thus there is no resultant voltage, and no current flowing between the machines. If now the two machines are slightly out of step, and *B* lags slightly, that is, its voltage reaches the maximum at a slightly later time, *b* in Fig. 4, and *A* leads slightly, that is, its voltage reaches the maximum at a slightly earlier time, *a* in Fig. 4, the two voltages *a* and *b* give

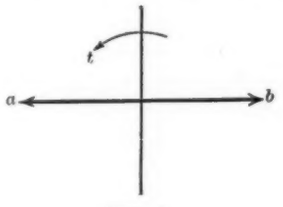


FIG. 3.

a resultant, which reaches its maximum midway between *a* and *b*, as shown as *c* in Fig. 4. This resultant or cross voltage of the two machines produces a cross current circulating between them. If now the circuit between the two machines, $a_2\ a_1\ b_1\ b_2$, should contain only resistance, but no reactance, the cross current *i* would be in phase with the cross voltage *c*, as shown in Fig. 5. It would then be practically in quadrature with the two machine voltages *a* and *b*, that is, would be a wattless current in the two machines, neither consume nor produce power, that is, there would be no synchronizing power.

Assume now that the resistance of the cross circuit is negligible compared with the reactance, then the cross current *i* would lag nearly ninety degrees behind the cross voltage *c*, which produces it, as shown in Fig. 6. Thus it would be approximately in phase with *a*, approximately in opposition with *b*, and would thus consume power in the leading machine *A*, that is, retard it, and supply power to the lagging machine *B*, that is, accelerate it, and thus pull the two machines together, as synchronizing current. Hence, the reactive or quadrature component (with regard to the cross voltage *c*) of the cross current is the synchronizing current, and the power component of the cross current exerts no synchronizing power. Thus, reactance is necessary for synchronous operation, and the larger the

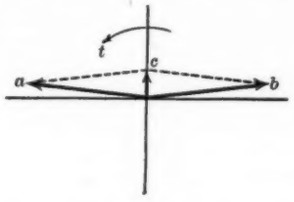


FIG. 4.

reactance is, compared with the resistance of the cross circuit, the larger a part of the cross current is synchronizing current.

Of the synchronous reactance of an alternator, essentially only the true or self-inductive component comes in consideration in synchronous operation, as the armature-reaction component is usually too slow to exert itself. In steam-turbine alternators, the self-inductive armature reactance is very low, frequently only two to three per cent; however, the armature resistance is a fraction of one per cent, and when connected to the same busbars, synchronous operation of such generators is satisfactory. A few per cent of resistance between the turbo-alternators, as may exist when operating two power houses together over a tie-line, makes synchronous operation unstable or im-

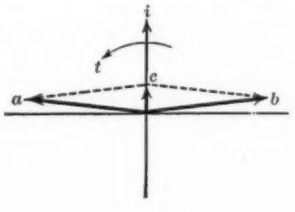


FIG. 5.

possible without the insertion of a corresponding amount of reactance.

Parallel operation of synchronous machines thus requires reactance in the circuit between the machines. It is further required, however, that the combined effect of resistance and reactance, that is, the impedance of the cross circuit, is sufficiently low to allow a large enough current to flow to keep the machines together against any tendency which separates them, as inequality of the driving power, slightly different speed adjustment of the engine governors, etc. That is, the possible cross current between the machines must be comparable in magnitude with their full-load current. This, however, is frequently not possible in the parallel operation of power houses distant from each other, over tie-lines. The capacity of the tie-lines between big power stations would economically be proportioned to the required exchange of power, and thus usually would not be sufficient to pull the two stations together into synchronism.

Here, then, another new problem arises which was not met previously in synchronous operation of alternators: the engine or turbine speeds of the two stations must be controlled, independently of the alternators, so as to be so closely the same under all conditions as to require a very small synchronizing power between the alternators, to pull into step and remain in step. That is, as we may express it, the prime movers must be

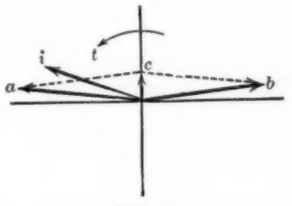


FIG. 6.

synchronized. While this had not been done before, it is a mechanical problem, which electrically can be solved without serious difficulty, for instance, by controlling the governor in the steam supply by the power exchange between the stations, in combination with sufficiently powerful dash-pots, to guard against governor hunting.

We must realize, that in the direct line of the modern central-station development is an extension of the power supply to that of an entire state or a number of states, from a few huge main stations near the centers of power demand, and numerous smaller outlying stations, with the entire system operating in synchronism through feeders and tie-lines, in which the power flow fluctuates in amount and in direction, and of which very few are sufficient to pull stations together into synchronism, but just sufficient to keep them in synchronism, if the speed regulation of their prime movers is independently maintained very closely the same.

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

A New Electric Train-Lighting System.

A new system of electric train lighting has been brought out in Europe by Brown, Boveri & Company, of Switzerland, and it is claimed to have many advantages. There are already about 2,200 outfits in service on various railroads and 1,000 more are soon to be delivered. These 3,200 equipments are designed for about 4,100 cars of all kinds, such as passenger cars, dining cars, mail and baggage cars, as well as locomotives. The Orleans Railroad, which centers at Paris, recently placed a large order for these train-lighting outfits. On the present system each car has its complete outfit so that the handling of the cars in no way depends upon the matter of the lighting. The same car can be used for high or slow-speed trains or for a long or short lighting period, at will.

Since the first systems of train lighting were brought out, a very important change has been brought about by the introduction of metallic-filament lamps by which is obtained from double to triple the light for the same current formerly used for carbon filament. Thus the size of the dynamo and battery can be much reduced and the electric system can now compete with gas and even supersede the latter, owing to the advantages which it possesses.

In electric train lighting there are two main points to be considered. First, the wear upon the battery, which should be as slight as possible so as to secure a long life. Second, an absolutely steady light is to be obtained. For these reasons the battery should not be overdischarged, and the voltage on the lamps should be constant and quite independent of the train speed or any other factor. It is also desirable to use a dynamo which is not of a special type, but of standard and solid construction, combined with a suitable regulator, as it is considered that a special dynamo which would answer all the requirement of train-lighting service would be so complicated that many disadvantages would ensue. The new generating and regulating apparatus takes care of the lighting properly and allows of working on the following principles:

1. The lighting is done by the battery only during the stopping of the train and for very slow speeds, below fifteen miles an hour, or even lower if need be. 2. The dynamo is put in circuit, when the speed exceeds the minimum speed for which it is regulated, and the voltage is exactly the standard voltage, and not only somewhere near the voltage, as is done by any ball-governor apparatus which throws on the dynamo independent of the voltage and thus gives rise to a bad change-over. All the other drawbacks of mechanical devices are suppressed, such as adjustment, variable working, friction, etc. 3. While the train is running above the minimum speed the lighting is carried out entirely by the dynamo. 4. At this same speed point, the dynamo commences to charge the battery, if it is not entirely charged, and this whether the lights are used or not. Charging is not done at constant current as in some systems, as this is very bad for the battery, but the charging begins with the maximum allowable current value, and the current then decreases by degrees down to zero when the battery is entirely charged. Thus there are no shocks and there is also avoided the large resistances needed for constant-current charging. The battery is well treated, and remains almost always charged without any overcharge. 5. The voltage of the dynamo and the charging of the battery are quite independent of the train speed and depend only on the regulator. 6. At the stopping of the train as well as at highest running speed the voltage on the lamps is independent not only of the speed but also of the current taken by the lamp circuit.

In Fig. 1 are shown the general connections of the dynamo, battery, lamps and regulator. The dynamo (Fig. 2) is of very simple build and is hung from the truck, using its own weight or a set of springs for stretching the belt. An automatic brush shifter reverses the brushes when the train is reversed, so as to keep the current in one direction.

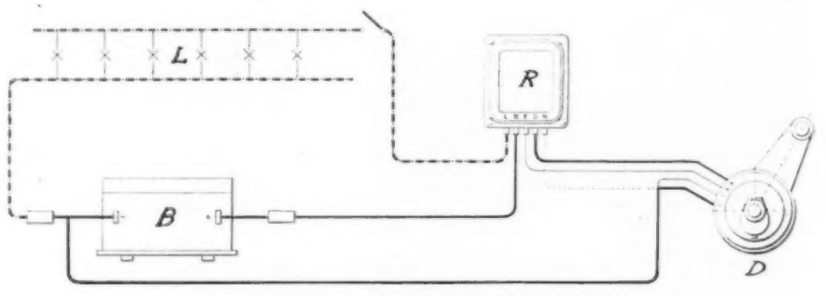


FIG. 1.—GENERAL SCHEME OF CONNECTIONS.

Oil-ring bearings are used and the dynamo is entirely ironclad. The battery is designed to supply the lighting current only during stops. About seven to ten hours is allowed for a maximum discharge. The cells are contained in boxes which are stowed on the train as usual.

As to the regulator (Fig. 3), it is designed to regulate the voltage of the dynamo, which of course depends on the speed, so that the battery may be charged and the lamps also run. When the train comes up to speed and the dynamo voltage reaches that of the battery, an automatic switch throws the dynamo on the battery and lamps. As the train speed rises, there is avoided a rise of voltage on the dynamo by throwing resistances in series with the dynamo shunt-field winding. The regulator has an arm working around contact points for putting in sections of resist-

ance coil. The arm is carried on a coil which rotates in a magnetic field, and this field is produced by three differential windings, first a circuit taken at the dynamo terminals, second a winding traversed by the battery current, both of these acting in the same sense, and third a winding carrying the lamp current and working in the opposite sense

As two extreme examples, take first the case of an express train running at high speed with but few stops and running in the daytime so that but little lighting current is used; in the second case, we may take a slow train with frequent stops, running at night and having a heavy lighting load. In the first case, the dynamo charges the battery and then should practically stop giving current. The regulator here acts so as to prevent any more current entering the battery which would do it harm. The dynamo thus is required to give but little current and besides works very unfavorably as it runs for a long time at a high speed without stopping. In the second case, the dynamo must keep the battery charged and also provide for the lamps while the train is running, so that much current is taken from the dynamo, seeing that we must avoid drawing unduly on the battery, as it would suffer from too great a discharge. Here the working is also unfavorable, as the dynamo works only during a relatively short time, owing to the frequent stops, and this at a slow speed. In all these cases of variable speed and stops, the regulator secures the proper working by automatically controlling the dynamo and battery circuits, reducing the voltage of the dynamo when need be by throwing in resistance. Seeing that the dynamo gives its full voltage for a train speed of fifteen miles an hour, there is no danger that this speed will not be reached, even by slow trains, so that the train is always lighted by the dynamo except during stops. The working of the present regulator is so exact that it allows of carrying the lighting by the dynamo alone without the aid of the battery, and this is an important point if, for instance, a battery fuse should blow when the train is running. With nearly all other systems, should an accident happen to the battery, the lighting is entirely put out of service.

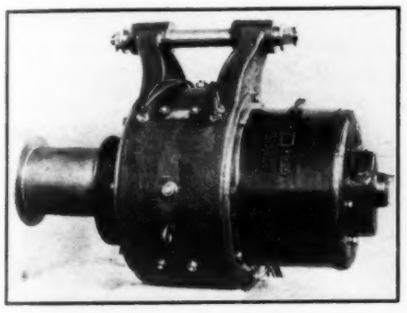


FIG. 2.—TRAIN-LIGHTING DYNAMO.

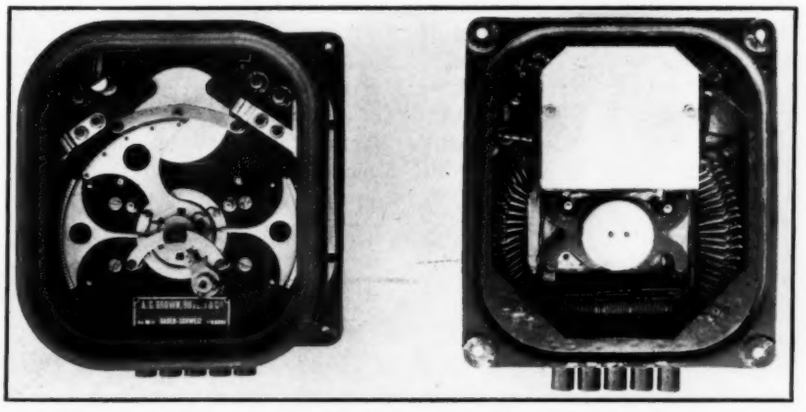


FIG. 3.—FRONT AND BACK VIEWS OF REGULATOR.

Warren, Ohio, Inaugurates New Street Lighting System.

That up-to-date and adequate street lighting is growing more and more in favor in American cities is demonstrated by the efforts many municipalities are putting forth to secure better lighted streets. A notable example of what can be done when once citizens have set their minds to accomplish this desired end is furnished by Warren, O., a city of about 12,000 inhabitants.

For two years the Board of Public Service has been busy with the problem of giving Warren an efficient and effective street-lighting system. The old arcs have now been discarded and the streets are illuminated by a complete installation of Mazda street series incandescent lamps — an installation unique from the fact that no other city has yet adopted this style of lighting to the exclusion of all others.

On the downtown streets and around the spacious park an ornamental lighting system employing standards has been installed. The majority of the standards support three lamps inclosed in large white globes and the artistic features of the complete standard add much to the attractive appearance of Warren's business streets. The light ing system in the residential streets, though not so spectacualr as that just mentioned, is characterized by neatness and utility. Ample light is now available throughout all parts of the city.

The official inauguration of the recently completed system took place on the night of June 7. The business section of Warren presented a stirring scene when from fifteen to eighteen thousand people witnessed the turning on of the lights. For ten days previous, preparations had been under way for a big carnival. Many visitors from a distance showed their interest in the new lighting system by being present to join in the celebration and the neighboring towns were represented in delegations, sent to take part in the parade.

Shortly after seven o'clock the program was officially opened by the Mayor, who, from an elevated platform, introduced the Hon. J. J. Sullivan, of Cleveland. In his brief address Mr. Sullivan reviewed many of the developments that had taken place in Warren during the past thirty years and commended the citizens on the public spirit they displayed in having achieved such fine results in the matter of night illumination of their streets.

At the close of the address Mayor Craver threw the switch at the rear of the platform which turned on the new Mazda lighting system. The transition from gloomy to brilliantly illuminated streets was greeted by a general exclamation of approval. The huge carnival parade put itself into motion, advancing towards the crowded business section on its way past the judge's stand.

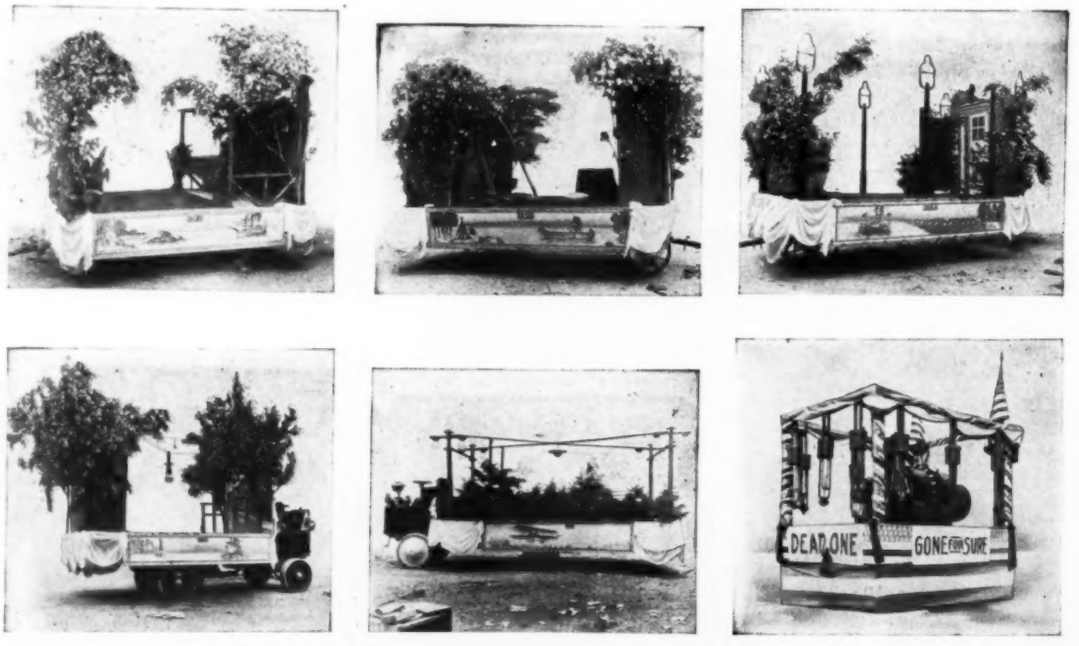
Warren, being a well-known incandescent-lamp manufacturing town, it is natural to suppose that the different factories would feature in the evening's entertainment. This they did in a very striking way by entering in the parade five large floats illustrating the evolution of light in America. The first float

showed Indians around the light from a camp fire, and was dated 1492. The next illustrated the introduction of the candle, in 1620. The use of oil and gasoline lamps was represented in the third, and showed the old style of oil street lights used in 1845. The introduction of the common carbon-filament lamps for street-lighting purposes was shown on the next float. This float carried a generator and the light-standards were fitted with carbon lamps, which were burning. The last float in this series showed a modern street-lighting system, representing a park scene in which the shrubbery was lighted with small Mazda lamps. The large three-light standards such as are used on the business streets in Warren, contained Mazda lamps similar to those now in use in that city. The Warren Water & Light Company, which holds the contract for street lighting in Warren, entered a float on which were loaded an old arc-light dynamo and some of the old arc lamps—labeled "Gone for Sure." Another float was that of the Peerless Electric Company. The harness of the horses drawing the wagon was illuminated with miniature lamps, while on the wagon were mounted a large gas-engine operating a series of fan motors and a large floral fan at the rear of the float.

The whole parade was led by a portion of the State Band, followed by a company of the Ohio National Guard in full uniform. Many other cleverly arranged floats, a large representation of men and girls from the various lamp factories, several lodges and many masqueraders took places in the long procession. The number of those in the parade was estimated to be between two and three thousand and it took fully an hour for it to pass the reviewing stand. The awarding of prizes was the last feature on the program.

DAY VIEW, MARKET STREET, WARREN, OHIO, LOOKING EAST.

NIGHT VIEW, MARKET STREET, WARREN, OHIO, LOOKING EAST.



REPRESENTATIVE FLOATS IN THE CARNIVAL PARADE, INAUGURATION OF NEW STREET-LIGHTING SYSTEM AT WARREN, OHIO.

Louisville Plant Completed.

The *Louisville Herald* for May 31 published a special sixteen-page section commemorating the completion of the George G. Fetter Lighting & Heating Company's plant. This plant in addition to suplying light, heat and power for the Fetter store, serves a number of consumers in the immediate vicinity. The capacity of the electric plant is 1,050 kilowatts.

The *Herald* published numerous articles dealing with the history and development of the project; also with the general business of the store.

Highly ornate tungsten clusters are being put on Michigan Boulevard, Chicago.

TELEPHONY—TELEGRAPHY, and WIRELESS.

New Developments in the Bellini-Tosi Directed-Wave System.

Since our former descriptions[1] of the new Bellini-Tosi directed-wave wireless telegraph system, the inventors have designed some new apparatus, which is especially intended to be used on vessels in order to enable them to find their bearings at sea during fogs.

The installation of the Bellini-Tosi apparatus on shipboard comprises four aerials, which are mounted as shown in Fig. 1, converging towards the upper part and joined together by means of a central frame of square shape, this latter being suspended by a cable that is stretched between the masts of the ship. Several wires are used for each aerial, and three such wires are shown here. They are attached together at the lower part near the deck and are then run up to the frame overhead. This frame is mounted at an angle of forty-five degrees with the center line of the boat. At the bottom, each aerial is connected to the wireless apparatus inside the cabin by a horizontal wire. This is one of the best methods of suspending the aerials, but others can be used according to the conditions which prevail on board.

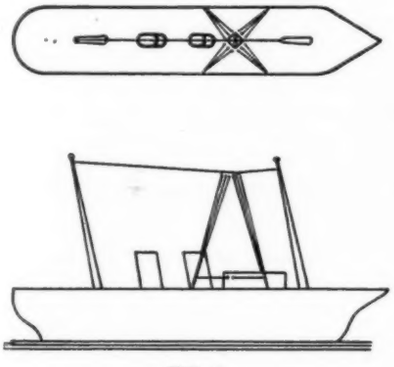


FIG. 1.

In Fig. 2 will be observed the method of mounting the apparatus. At *R* is the device which is used by Messrs. Bellini and Tosi for directing the waves or for receiving waves from another station. There are two fixed coils, *1* and *2*, mounted at right angles; each coil is connected to a pair of aerials, thus coil *1* is connected to aerial A_1 and A_2 and coil *2* to A_3 and A_4. A movable coil, mounted within the former, can be rotated about its axis and carries a pointer moving over a graduated scale. It is connected to a circuit (for receiving) which contains a fixed condenser *C* and a variable conductor *C'*). A telephone *T* is connected to *C*, and a mineral detector *D* to *C'*, as shown.

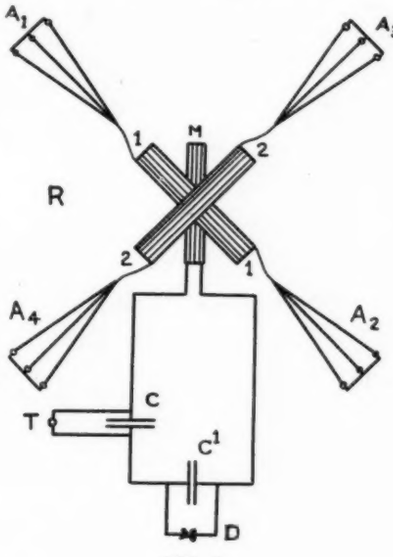


FIG. 2.

Each pair of opposite aerials, together with the corresponding coil of the apparatus, forms an aerial system together with the horizontal wire, so that we have in reality two crossed aerials or loops, these loops being of triangular shape and nearly closed. Loop *No. 1* includes aerial A_1, coil *1*, aerial A_2 and the horizontal wire, and loop *No. 2* crosses the first at right angles. It will be remembered that each loop is acted upon at the maximum degree by waves coming from a post lying just opposite it or in its axis, and at zero (or no effect) by a post lying directly at one side or at right angles to the former. If a distant post lies forty-five degrees from the vessel's axis, or in the axial line of loop *No. 1*, only this loop will be affected. When the post is midway, or in the boat's axis or perpendicular to it, both loops are affected, but with less intensity for each. With posts at various points around the horizon, both loops are more or less acted upon, depending on the angular position of the post. However, each coil sets up a magnetic field and, as the fields are crossed, there will be a resultant magnetic field depending for its direction upon the value for each coil. This field therefore depends upon the position of the distant post, and by rotating the inner movable coil we can perceive in the telephone when the sound is the strongest, and the pointer on the graduated circle shows at once the direction of the distant post. In the same way waves can be directed to any point in the horizon by using a transmitting circuit upon the movable coil. In practice a separate instrument is used for transmitting and receiving.

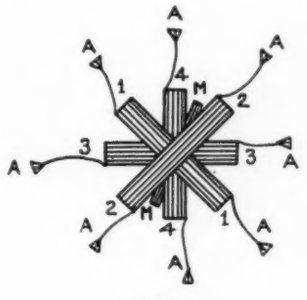


FIG 3.

Below is described a recent improvement which consists in using four crossed coils (Fig. 3) and eight aerials, or double the number originally used. The principle is the same as before, but the present method is found to shorten up on the required length of the horizontal wire, and takes up less room on board for this season. A new instrument, Fig. 4, is therefore used which contains four fixed coils and an inner movable coil. This apparatus, known as a radiogoniometer

[1] See ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, October 30, 1909, page 838, and July 16, 1910, page 115.

or wireless compass, somewhat resembles the preceding type and is constructed at the Ducretet establishment at Paris.

With the present apparatus a vessel can find its bearings when nearing the coast by taking the direction of two known shore stations. The method is quite the same as is used commonly by making sighting observations upon two known shore points. When there is but one wireless post, two readings are made, taking account of the speed of the vessel. As there are often many wireless shore posts working, the method becomes easy, and again the vessel can call upon such posts to send signals.

Without going into further detail, it will be seen that the method is valuable, as it allows a vessel to find its distance from shore in time of fog and thus make a safe landing. For large passenger steamships, a coal economy will result, as the vessel can run at full speed and make a quicker landing. Collisions between steamers are also avoided. It will be of interest to state that the Bellini-Tosi apparatus is being installed on ocean steamers of the Compagnie Generale Transatlantique, and the *Provence* will be the first to be equipped. For further data about the system we would refer to the article last year describing the French Government station erected at Boulogne on the Channel coast.

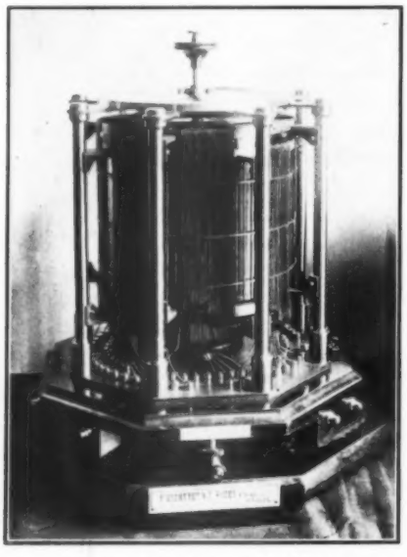


FIG. 4.—NEW FORM OF RADIOGONIOMETER.

In the course of a recent address in England, the premier of New Zealand, Sir Joseph Ward, advocated laying a Government cable to connect all possessions of the British Empire.

MULTIPLEX TELEPHONY.[1]

BY ERNST RUHMER.

During my first researches with electric wave telegraphy in the summer of 1906, I conceived the idea of applying the principles of wave telephony to wire telephony and in this way solving the problem of multiplex telephony. After several preliminary experiments in this direction, I succeeded in the spring of 1908 in sending five telephonic messages over the same circuit, extending from my laboratory to my residence, without mutual disturbance. These experiments were later repeated many times in the presence of various friends and interested parties. These and later experiments were based upon the following method:

At each sending station undulating high-frequency alternating-currents were generated, analogous to the electric waves in wireless telephony. The frequencies were different at each station. All of these high-frequency currents were transmitted over a common circuit and were again separated at the receiving stations through the medium of resonating circuits to one of which each receiving telephone was connected. The coupling between the transmission line and the individual receiving circuits, as well as that between the latter themselves, must be as loose as possible in order to secure the complete separation of the individual messages and to prevent the least interference. Fig. 1 shows an example of three corresponding transmitting and receiving stations. At each sending station high-frequency currents are generated by means of a Poulsen arc, burning in an atmosphere of hydrogen, with a resonating circuit in parallel. The three resonating circuits are adjusted for different frequencies by a proper selection of inductances and condensers. The intensity of the high-frequency currents flowing in these circuits is influenced by the microphone *M*. This can operate through the supply current as in the first and third cases or by insertion in the high-frequency circuit itself as in the second case. Various arrangements are possible here, providing only that the microphone at one sending station does not influence the current in the transmission line due to any other sending station.

The three receiving stations at the right of the diagram correspond to the three sending stations. In the resonating circuits at these points detectors, *D*, may be inserted as in ordinary wave telephony and act upon the individual receivers *T*, or the variations in the alternating current can be transformed into sound waves by the direct application of a condensing or eddy-current receiver. The transmission of the different conversations takes place over a common transmission line *F*, which is coupled proportionally strongly to the transmitting circuits, but loosely to the receiving circuits. While the transmission line is traversed by currents of all frequencies which are imposed upon it, the individual resonating circuits at the receiving stations take up only those components corresponding to their own

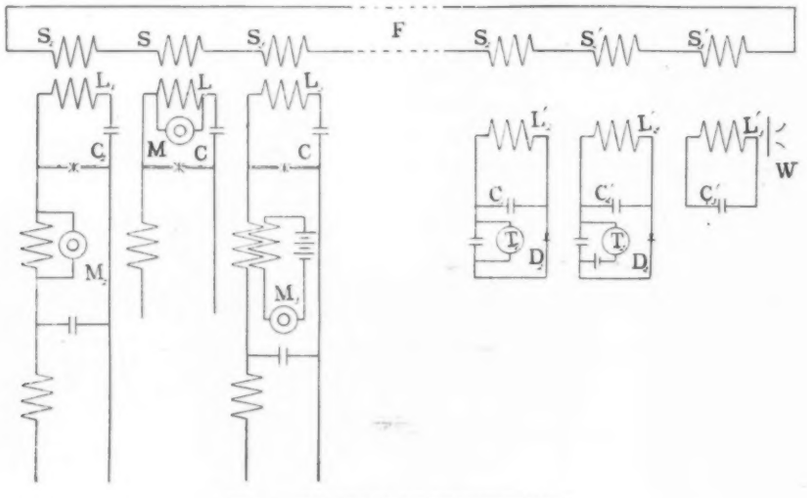


FIG. 1.—DIAGRAM OF CONNECTIONS.

1 Translated from *Zeitschrift fur Schwachstromtecknik* and *Electrophysikalische Rundschau.*

free periods, so that each receiving station receives only the message sent from the corresponding sending station.

At the request of Dr. Goldschmidt, I prepared in 1909, a set of apparatus including sending and receiving stations for the Brussels Exposition. Owing to the fire which occurred there shortly after the receipt of this apparatus, it was never set up. This apparatus is illustrated in Figs. 2 and 3.

The Poulsen arc lamps which served as generators of the high frequencies are mounted on the board below the other apparatus and are supplied from a common source. To prevent any action of one transmitter upon another through this circuit, coils of high inductance are inserted in the leads to each lamp. In parallel with each lamp, in addition to its resonating circuit,

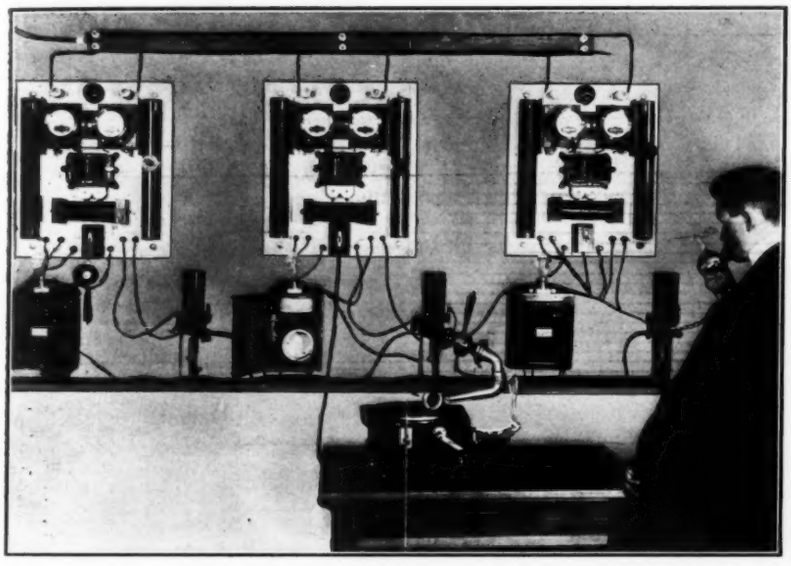


FIG. 2.—SENDING APPARATUS FOR MULTIPLEX TELEPHONY.

there is connected a "fly-wheel circuit" (German patent No. 225459) which serves to hold the frequency and current more constant. The resonating circuits and the apparatus for coupling with the transmission line are in the cases to be seen at the left of each lamp. These also contain a control lamp and a switch. The line circuit traverses all three transmitters. By means of the switches above mentioned, any station can be connected to the transmitting circuit when it is wished to send a message. At the receiving stations there is permanent connection with the transmitting line, so that whenever a station is called its bell is operated by means of a relay. When the receiver is removed from the hook the connection between the two stations is completed. At the same time other stations may be called or used for messages without any interference or possibility of overhearing other messages.

The fundamental basis and the principal methods of connection for this system of multiplex telephony are covered by a number of patent applications, of which several have already been issued (Belgian No. 224008, March 16, 1910; French No. 415013, April 5, 1910). Although these researches appear of the utmost physical interest and appear to be identical in general idea with those proposed by Squier, they did not satisfy me from a practical point of view, principally because it would be impossible to supply every telephone subscriber with a high-frequency generator (either arc lamp or machine). There are two possibilities for overcoming these difficulties. One consists in generating the high-frequency currents at the central office, the other in the simplification of the apparatus itself. On account of various patent applications which are now pending it is necessary to confine this discussion to the latter method.

I have invented a materially simplified transmitting apparatus for telephonic waves in which the high frequencies are generated by the microphone itself (German patent No. 225056). This apparatus permits of simultaneous speaking and listening and corresponds to the ordinary telephone apparatus particularly with reference to simplicity. I hope after the issue of the patents now pending and the completion of further researches to discuss this matter more fully. The present communication is intended only to serve to show my priority over Squier, since heretofore nothing has been known by the general public of my experiments.

Water Power in Sweden.

The rightful ownership to a great deal of Sweden's water-power, especially in the north of the country, seems to give a good deal of trouble owing to the claims put forward by the State. Some Swedish companies, the Gidea and Husum Company and the Mo and Donisjo Company, which are intent upon exploiting the water-power of the Gide River and the Torrbole Fall in the Ore River, respectively, which they claim to be theirs, have now petitioned the State for a definite statement as to whether or not the old rule that he who owns the shore owns the water applies.—*Engineering.*

Wireless Stations in Indo China.

Le Courrier de Haiphong states that the Executive Council, when it last

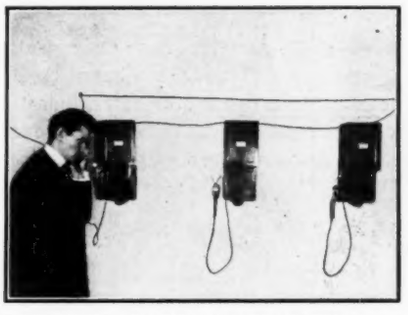


FIG. 3.—RECEIVING APPARATUS.

met at Hanoi, voted 90,000,000 piasters for the establishment of wireless telegraph stations in Indo China. In the project of Captain Peri it is contemplated to make Saigon the center, with apparatus ranging up to 4,000 kilometers. When once installed communication with Pondichery, Singapore, Batavia, Manila, Hongkong, and different smaller stations will be easily established before long on the coast of Annam and Tongking. A second station is to be established on the summit of Nuikem, which is about 476 meters in height, not far from the gold mines of Bong-Mieu, which should furnish the necessary electric power to communicate with Pnom-Penh, Vientian, Saigon, and Kien-an Phulien.

Industrial Power

Interpole Motors.

Economy of weight and floor space, high efficiency, sparkless commutation under sudden and severe loads, close speed regulation and large ranges in speed are some of the factors that have created a demand for interpole motors.

The primary factor in any machine is operation. Light weight and small floor space are of little value if the machine attains excessive temperatures, commutates badly even under twenty-five-per-cent overload, or has any faults that shorten its life or make it at all dangerous to operate.

To make the yoke or frame as light as possible, cast steel is used. A glance at Fig. 1 will show the relative permeability of cast steel and cast iron. Cast steel becomes saturated at a much higher density than does cast iron. A larger section of the latter is, therefore, necessary for carrying the same flux. Take for example a point on the curve corresponding to a density of fifty-thousand lines per square inch. Cast steel would require but seventeen ampere-turns per

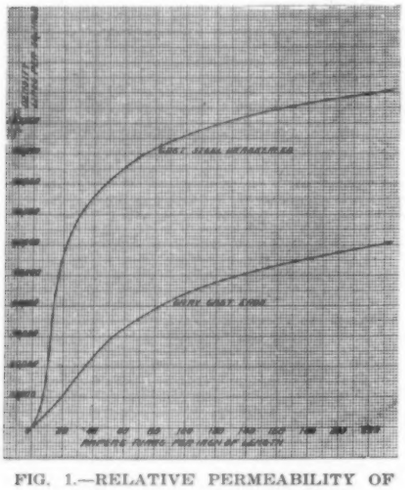


FIG. 1.—RELATIVE PERMEABILITY OF CAST STEEL AND CAST IRON.

inch of length while cast iron would require 135 ampere-turns per inch of length. The relative weights for carrying the same total flux are evident.

The main poles are built up of steel plates. The tips of horns are beveled and the plates should be stacked to give a toothed effect as shown in Fig. 2. The bevel increases the reluctance in the path of the armature-reactance ampere-

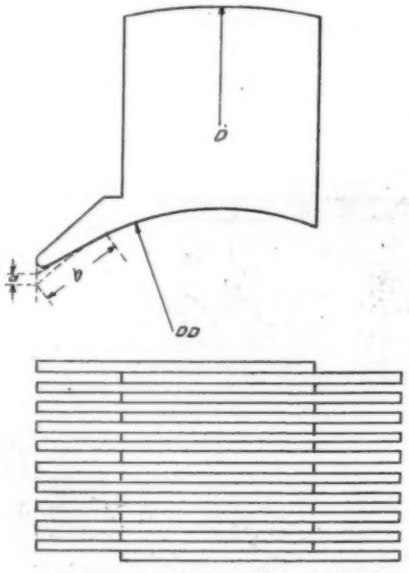


FIG. 2—DIAGRAM OF MAIN POLES.

turns by increasing the air-gap length and the laminated or toothed-pole tip serves a similar purpose by working the metal at a density greater than that of the pole body or pole face. The small air space between the steel plates minimizes eddy-current and hysteresis losses, thus increasing the efficiency of the machine. The laminated construction makes a square pole of uniform dimension and of homogeneous structure. Blow holes in pole pieces are avoided and speeds of machines built on the same specification are uniform.

Interpole pieces are built of cast steel or wrought iron. Laminated pole shoes are sometimes used on interpoles but excellent results are obtained when the interpole is a rectangular-shaped piece of metal having one end turned to fit the yoke and the other end bored to the same diameter as that of the main poles. The axial length of the interpole piece is approximately seventy-five per cent of the armature-core length.

The armature is built of number twenty-eight gauge electrical sheet steel, and the laminations are given a thorough coating of insulating varnish before assembling.

The main poles and interpoles should be very carefully spaced in the yoke. If one interpole piece is one-sixteenth of an inch out of spacing at the air gap, it will generally be shown by bad commutation at the brush stud which is influenced by that pole.

Given, then, an interpole motor built along the foregoing lines, the adjustments for best operation may be classed under the following heads: (a) Armature centering; (b) brush spacing and fit; (c) brush position; (d) interpole strength; (e) faults in interpole winding.

Armature Centering.—If the machine has self-contained bearings, trouble does not often occur from improper armature centering. With pedestal bearings, however, an eccentric armature will be indicated by bad commutation due to an uneven air gap, by hot bearings due to the magnetic pull of the

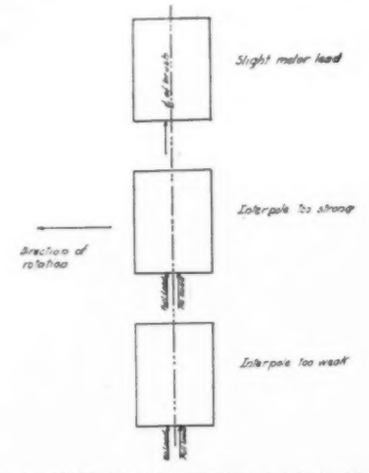


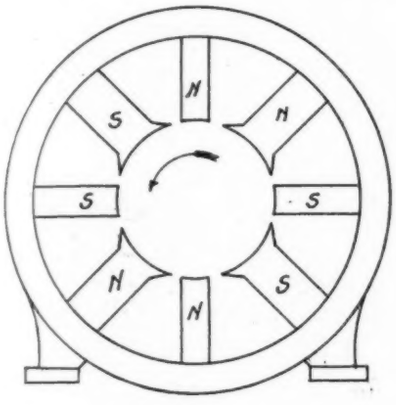
FIG. 3—DIAGRAM OF THREE BRUSH POSITIONS.

armature or by excessive armature-core temperatures.

In large machines, the magnetic pull for one-thirty-second of an inch displacement from a concentric position, is approximately equal to the weight of

the armature. An armature can be centered within one or two thousandths of an inch by means of an air-gap gauge. For machines having less than one-quarter of an inch clearance on a side, a convenient gauge is one tapered from no thickness to one-quarter of an inch and ten inches long, having a width of approximately three-sixteenths of an inch.

If this is divided into ten equal divisions the difference in thickness between any two consecutive division lines is twenty-five thousandths of an inch. Select a spot on the armature and mark it carefully. Turn the armature until this spot comes successively under each pole-piece center, measuring the air gap



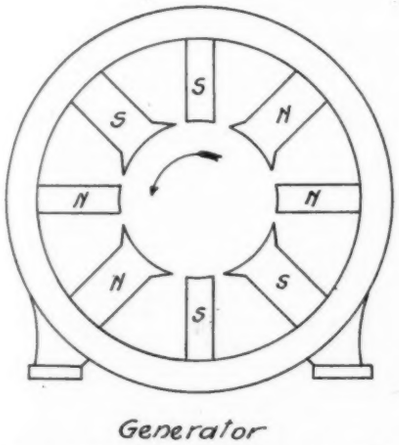


FIG. 4—POLARITY OF MOTOR AND GENERATOR.

at each pole. A comparison of these measurements will indicate which way the armature or yoke is to be moved. It is advisable in most cases to use the interpole pieces for centering since the unevenness of a laminated pole is sometimes misleading. For high-speed machines running on weak fields, armature centering is exceedingly important. The armature should also be in the center of the field axially, or it may "shoulder" on one bearing due to the fact

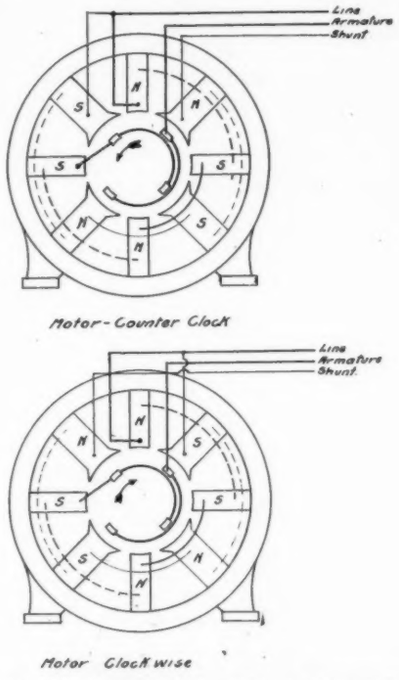


FIG. 5—CONNECTONS FOR CLOCKWISE AND COUNTER CLOCKWISE ROTATION.

that it is trying to run in the center of its magnetic field.

If an armature core is unevenly or loosely stacked so that it is non-uniform, shouldering may develop. Sometimes this can be remedied by bending the pole-tip laminations at an angle, thus throwing the resultant pole flux away from the mechanical machine center and causing the armature to float freely.

Brush Spacing and Fit.—Too much emphasis cannot be laid on the adjustment of the brush rigging. If a box holder is used the brush must have a sliding fit and the direction of the spring tension must be such that the brush will have no tendency to run on the toe. The spacing of the brushes must be exceedingly accurate. The writer has corrected bad commutation under one or two brush studs on a four-pole machine by correcting the spacing of one stud which was approximately one-sixteenth of an inch out of spacing.

The most accurate method of spacing the brushes is by means of a piece of paper about three-quarters of an inch wide, equal in length to the periphery of the commutator, and divided into as many equal parts as there are brush studs. The paper should be glued to the commutator during the spacing process. This method is correct for mechanical spacing. If, however, there is an error in machine work or a bad spot in the yoke casting the electrical spacing may not correspond with the mechanical spacing.

Bad commutation has been corrected by placing one brush stud out of mechanical spacing to get the brushes on that particular stud on the electrical neutral point. If a brush is not making contact over its entire surface, bad commutation, high speed, or racing may occur. The commutator temperature may be excessive on account of the increased contact resistance due to a small contact area. Rubbing the brush-

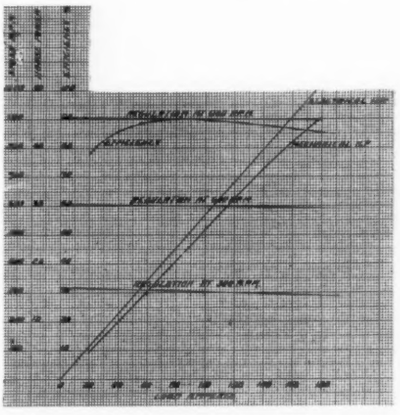


FIG. 6—CHARACTERISTIC CURVES OF TWENTY-FIVE-HORSEPOWER MOTOR.

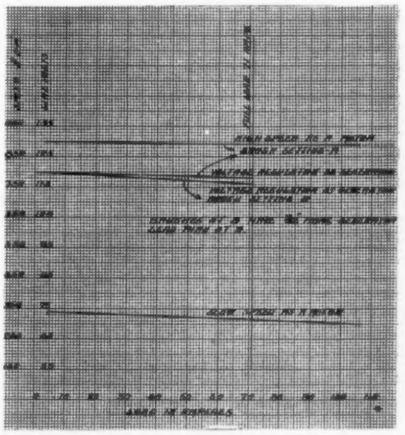


FIG. 7—CHARACTERISTIC CURVES OF TEN-HORSEPOWER MOTOR.

es with fine garnet or sand paper with no pressure on the brush other than that of the spring, drawing the paper close to the commutator, and in the direction of rotation, will give a surface which in a short time will insure contact of the whole brush area.

If the brushes are copper plated, this

plating should be stripped from the brush at least a quarter of an inch from the commutator since the fine copper particles at the brush edge cause bad commutation.

Brush Position.—In the ideal interpole motor, the no-load and full-load neutral points will be together and the proper brush position will be such that the common neutral is directly under the center of the brush. Most machines operate best, both with respect to speed regulation and commutation if the brushes are given a slight motor lead, say approximately one-sixteenth of an inch as shown in Fig. 3. Sometimes it is necessary to sacrifice close speed regulation to maintain full-load speed by giving the brushes a generator lead. If the commutation is number one, no increased commutator temperatures will occur due to this brush position.

Interpole Strength.—If the interpole is too strong, the full-load neutral will be in advance of the no-load neutral as shown in Fig. 3. If it is too weak the full-load neutral will be back of the no-load neutral. Sometimes there are two full-load neutrals. This indicates either a weak interpole or a false brush position.

For locating neutral points, two pieces of No. 15 German silver wire, insulated from each other and taped together in such a manner that the ends are separated about one-eighth of an inch, are soldered to a length of lamp cord. These points held on the commutator will give the instantaneous voltage either positive or negative and the neutral position can be located very accurately by means of a double-swing voltmeter having a range of from zero to one and one-half volts in both directions.

Give the brushes a slight motor lead at no-load. If the interpole strength is too great, the motor will race when the load comes on. A shunt in parallel with the interpole winding can be adjusted to give the proper interpole strength to bring the neutrals together. Care must be taken in adjusting this shunt to insure operation without undue heating of the same. On account of its comparatively constant temperature coefficient German silver is the best material for a shunt and a forty-degree centigrade rise in temperature is entirely satisfactory.

A user reported that a certain machine operated all right for about an hour, after which time it began to "race" or vary rapidly in speed. Investigation showed that the shunt to the interpole winding was of too small cross section. When it became warm its resistance became of such a value that the interpole was strengthened, thereby causing "racing." A new shunt having ample cross section for cool operation removed all difficulties.

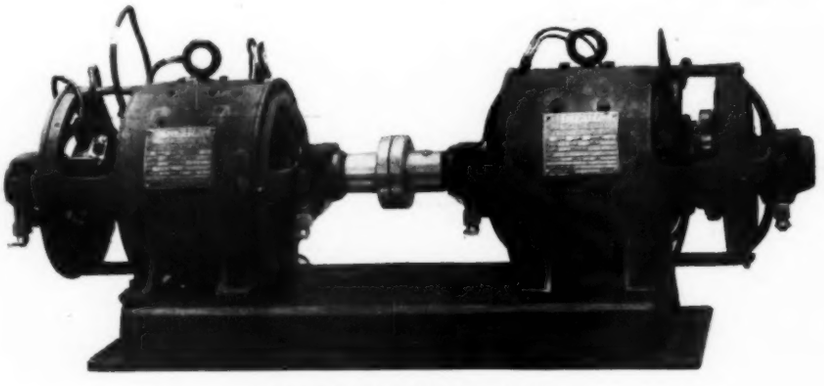
If the interpole is just a trifle too strong, the operation may be entirely safe, there may be no tendency to "race" even under fifty-per-cent overload and still the machine may have a rising characteristic, *i. e.*, it may run faster under full load than at no load. In some cases this may be advisable. For example, a motor-generator set consisting of a shunt-wound direct-current interpole motor, driving a separately excited shunt-wound alternating-current generator for wireless work, was so adjusted that the speed was approximately 1,780 revolutions per minute at no load while under full load it was 1,820 revolutions per minute. This increase in speed, while not enough to cause a disadvantageous variation in frequency, was sufficient to keep the generator-voltage regulation very close.

If the interpole is slightly weak it can often be sufficiently strengthened by placing a "shim" under the interpole pieces, thus decreasing the air gap. If it is very weak, a new interpole winding having more turns per coil is necessary.

Faults in Interpole Winding.—In a motor the main pole and the interpole following in the direction of rotation should be of the same polarity, as shown in Fig. 4. In a generator the opposite is true. Polarity can be checked by means of a compass. If the entire winding is reversed, bad commutation will occur or the starting current will be excessive. The interpole can be brought into right relation with the armature by reversing the interpole leads or shifting the brushes 180 electrical degrees. Shifting the brushes will change the direction of rotation and a change of main field will be necessary for operation in the original direction.

It is obvious from this that the direction of rotation cannot be changed by shifting the brushes as is often done with a plain shunt machine without interpoles. The interpole winding must at all times be in the same relation to the armature and must be considered a part of the latter when reversing the direction of rotation of the machine. Connections for clockwise and counter-clockwise rotation are shown in Fig. 5.

The reversal of short-circuiting of one particular interpole coil is generally indicated by sparking under one brush stud, although more frequently it causes bad commutation all around. A reversed coil can be readily located with a compass and a "shorted" coil can be found by measuring the resistance.



WIRELESS-TELEGRAPH SET.

If one side of the line is grounded, a grounded interpole winding will generally give evidence in operation similar to that of a machine with a weak interpole, that is, commutation will be bad.

The examples following will serve to illustrate the fine results obtained with properly designed interpole motors.

Characteristic curves of a twenty-five horsepower, 230-volt, 300/900-revolutions-per-minute shunt-wound adjustable-speed motor are shown on Fig. 6. This machine was designed with a view to obtaining high efficiency, close speed regulation throughout the range and stability of operation under rapidly changing field strength and quick fluctuations in load from no load to fifty-per-cent overload. Full load is at ninety-six amperes, corresponding to an effi-

ciency of ninety per cent. The high light-load efficiencies are characteristic of interpole machines. The speed regulation of this machine is especially close, being eight revolutions or less than one per cent at full speed, nine revolutions or 1.5 per cent at 600 revolutions and sixteen revolutions or five-and-one-third per cent at full field. The machine was stable at fifty-per-cent overload in both directions and this load could be applied in one step without any ill effects. The field rheostat could be turned from full-field position to maximum weak-field position very rapidly under load without bad commutation or any tendency to race.

Fig. 7 shows some curves taken on a ten-horsepower, adjustable-speed motor having a three to one speed range. Conditions of service are such that the machine at times runs as a generator. By giving the brushes a slight motor lead, the voltage regulation as a generator was within two per cent, the voltage dropping as the load came on from 120 volts no load to 118 volts at full load. The speed was held constant at 900 revolutions per minute. With this brush setting the motor was stable with a fifty-per-cent overload and the speed regulation was as good as could be expected.

An interpole motor can be brought up to speed very quickly. Fig. 8 illustrates a two-kilowatt wireless-telegraph set, consisting of a direct-current shunt-wound interpole motor coupled to a separately excited single-phase, 480-cycle alternator. The line current of the motor passed through the series winding of the generator for the purpose of compounding. The generator had sixteen poles and the rated speed was 3,600 revolutions per minute. This arrangement gave constant frequency and voltage within one-half of one per cent of a straight line from no load to full load. The set was started from rest and brought to full speed in four seconds by means of an automatic starter with no tendency to "race" or commutate badly. Another case of a quick start was that of a thirty-three-horsepower shunt-wound interpole motor, direct connected to a blower having a capacity of 25,000 cubic feet per minute, and running at a speed of 790 revolutions per minute. With the blower attached, the motor was brought from rest to full speed in seven seconds. This motor had an efficiency of ninety-two per cent.

Probably one of the greatest uses for interpole motors is in elevator work. An instance of this severe service is a fifty-horsepower motor running from 400 to 800 revolutions per minute. The field was reduced from full field to a value corresponding to 800 revolutions per minute in one step, with load on. The commutation was first class and no tendency to race was evident. This motor had remarkably close speed regulation, being flat in both directions of rotation.

Large ranges in speed can be obtained with an interpole machine. Machines having a capacity of ten horsepower throughout the entire range of speed are quite common with a five to one speed ratio. The high speeds are obtained by field weakening. When running on weak field, an interpole motor is very sensitive to brush position, and interpole strength. With these features properly adjusted it is almost impossible to make the commutation bad, either by rapid change in speed or by applying overloads.

In conclusion, with properly designed, carefully adjusted interpole motors one can expect a small, efficient machine, having close speed regulation, large range in speed, large overload capacity and sparkless operation which means a long-lived commutator.

The Future of Electric Furnaces.

Commenting editorially on the significance of electro-steel, the *Mining World*, in a recent issue, calls attention to the vast possibilities in the adaption of the electric furnace not only to steel refining, but to the economical direct-smelting of iron ores, and the roduction of pig-iron. This will render possible, indeed it has already materialized into, the development of iron and steel centers where coal is commercially out of the question. Norway and Sweden, Italy, too, and Alpine Europe have in the past six years assumed a prominent, and previously quite unheard-of position among the world's leading steel producers. An important international political question in Europe today has been directly initiated by the sudden and successful development of electric iron and steel smelting in Norway and Sweden. These countries have almost over night grown into powerful competitors against Germany, so that Sweden is now proposing a shutting off of Germany's supplies of iron ores from Scandinavia, and the retention or "conservation" of the peninsula ore deposits for national development.

All this has been made possible by the utilization of electric power in the mountain fiords, and Italy, too, has profited wonderfully by the same power. In our own country, at Heroult, Cal., similar developments have taken place, where mountain streams have been harnessed to the smelting of nearby iron-ore deposits, in regions where coal is out of consideration.

The developments associated with the electric furnace will ultimately bring about the utilization of vast reserves of iron ores now lying dormant in the Appalachians, in the South, in the western states, Alaska, the Hudson Bay region, Brazil, and elsewhere where coal is unavailable for smelting, and where water power may be easily harnessed. Nor should it be overlooked that the electric furnace permits the utilization of inferior ores, containing impurities which would be fatal to smelting with fuel; yet, withal, there is turned out a better and more valuable metal product. Then, too, the advances in hydroelectric construction and power transmission are playing a potent role in the development of the electric furnace, not only for smelting iron, but for smelting copper, lead, zinc and for electrometallurgic and for electrochemical processes in general.

Coal or fuel supplies have ceased to be an essential factor in iron and metal smelting. We may yet live to see the map of the world's metal industries materially changed, and electricity from the mountain stream and the waterfall supplant coal as the basis of industry.

Electrification in Berlin.

The greatest suburban railroad in Europe, the Berlin Stadtbahn, is about to be electrified, largely through the Kaiser's influence. The cost is estimated at $30,000,000. Experts have decided that the plan not only is entirely practicable but that it is almost necessary in order to relieve Berlin of soot and smoke.

Electrolysis in New Orleans has assumed such proportions that the damage traced to it each month is estimated at $1,500 to $3,000, according to city officials.

FINANCIAL REPORT OF ELECTRICAL COMPANIES.

NEW YORK TRACTION.

The revenue passengers carried by the various New York traction lines during the month of April compares as follows:

	1911	1910
Hudson & Manhattan...	4,847,324	4,164,024
Interboro sub. div.....	25,762,225	24,350,136
Interboro elev. div.....	26,012,052	25,528,387
B. R. T. cos.....	35,536,468	33,793,261
Manhattan surface:		
*Metropolitan Street	21,812,244	21,731,379
Cent. Pk. N. & E. Riv..	1,005,907	1,018,625
*Second Avenue.....	1,346,392	1,235,884
*Third Avenue	4,128,690	3,952,735
*Dry Dock, E. Bway & Battery	886,932	911,558
*42nd St., etc.....	2,447,441	2,185,812
Bronx surface:		
N. Y. C. Interboro.....	499,663	404,962
Southern Boulevard	183,883	169,732
*Union	3,471,518	3,234,632
*Westchester Elec.	711,214	748,179
Queens surface:		
Long Island Elec.....	266,355	261,496
N. Y. & L. I. Trac.....	613,257	552,049
N. Y. & Queens Co.....	1,904,984	1,659,066
Ocean Electric	92,190	89,871
Coney Island & Bklyn...	2,255,426	2,161,516
Total of above.....	133,804,155	128,153,352
Other companies.....Est.	1,250,000	1,208,457
Grand total	135,054,000	129,361,809

*Operated by receivers.

The revenue car miles for all New York Traction lines for April, 1911, amounted to 25,363,000, compared with 23,944,893 in 1910 and 22,438,895 in 1909.

MONTREAL STREET RAILWAY.

The report of the Montreal Street Railway Company for month of May and eight months ended May 31, 1911, compares as follows:

	1911	1910
May gross .....$	431,689	$ 370,234
Expenses	216,730	199,617
May net	214,959	170,617
Charges and taxes.....	60,346	48,977
May surplus	154,613	121,640
Eight months gross.....	3,006,913	2,707,235
Expenses	1,787,922	1,607,443
Eight months net.....	1,218,991	1,099,792
Charges and taxes.....	339,889	306,147
Eight months surplus.....	879,102	793,645

KINGS COUNTY ELECTRIC LIGHT & POWER.

The report of the Kings County Electric Light & Power Company for the month of May and five months ended May 31, 1911, compares as follows:

	1911	1910
May gross .....$	377,124	$ 340,101
Expenses	201,108	169,380
May net	176,015	170,721
Charges and depreciation...	109,959	100,773
May surplus	66,056	69,948
Five months gross.....	1,965,920	1,754,154
Expenses	967,402	824,400
Five months net.....	998,518	929,754
Charges and depreciation...	558,892	507,025
Five months surplus.....	439,626	422,729

NEW YORK STATE RAILWAYS COMPANY.

The report of the New York State Railways Company for the quarter ended March 31, 1911, compares as follows:

	1911	1910
Total operating revenue.....$	815,893	$754,594
Total operating expense.....	499,950	504,519
Net operating revenue.....	315,943	250,074
Taxes accrued	59,042	56,895
Operating income	256,900	193,178
Non-operating income	152,023	39,741
Gross income	408,924	232,920
Total deduct. from gross income	145,706	107,593
Net corporate income.....	263,218	125,326

MEXICAN TELEGRAPH COMPANY.

The Mexican Telegraph Company reports for the quarter to end June 30, 1911, partially estimated, income compared as follows:

	1911	1910
Gross .....$	210,000	$ 207,000
Expenses	41,000	42,500
Net	169,000	164,500
Other income	27,626	26,000
Total income	196,626	190,500
To Mexican Government...	11,500	9,500
Balance	186,126	181,000
Dividends	89,735	89,735
Surplus	95,391	91,265
Previous surplus	2,673,741	2,307,874
Total surplus	2,769,132	2,399,139

CENTRAL & SOUTH AMERICAN TELEGRAPH.

The Central & South American Telegraph Company reports for the quarter to end June 30, 1911, partially estimated, income as follows:

	1911	1910
Gross .....$	395,000	$ 435,000
Expenses	162,000	162,500
Net	233,000	272,500
Other income	750	2,750
Total income	233,750	275,250
Dividends	143,565	143,565
Surplus	90,185	131,685
Previous surplus	2,347,257	1,886,151
Total surplus	2,437,442	2,017,836

AMERICAN LIGHT & TRACTION.

Th report of the American Light & Traction Company, for the month of May and five months ended May 31, 1911, compares as follows:

	1911.	1910.
May gross .....$	309,609	$ 273,044
Expenses	9,907	8,998
May net	299,702	264,046
Five months gross.....	1,696,649	1,513,822
Expenses	47,056	45,629
Five months net.....	1,649,593	1,468,193

HUDSON & MANHATTAN.

Th Hudson & Manhattan Railroad Company reports for the month of May, compared as follows:

	1911.	1910.
Gross revenue, all sources.....$	389,941	$340,367
Expenses and taxes.....	167,254	131,675
Gross income	222,687	208,692
Interest on bonds, outstanding.	250,697	243,958
Less interest charged to construction	55,877	73,020
Balance	194,820	170,938
Other charges	24,185	21,039
*Total deduct	219,005	191,977
Surplus	3,682	16,715

*Being fixed charges applicable against that portion of the property employed in present operations.

From July 1 to April 30, gross revenue amounted to $3,950,650; gross income after expenses and taxes, $2,159,325; deficit after charges, $54,406.

New Plants at Niagara Falls.

As a result of the increasing demand for axle car-lighting systems, the United States Light & Heating Company has found it necessary to erect a new factory on its site at Niagara Falls. The factory, which was recently completed, was built on a twenty-one acre tract of land about one and one-half miles from the Falls and is the largest plant in the world for the manufacture of electric car-lighting equipments.

AMONG THE CONTRACTORS AND SUPPLY MEN

B. P. DUBINSKI, El Paso, Tex., was awarded the contract for doing the inside wiring of the new buildings at Fort Bliss, Tex.

J. B. ACKLEY, Raymond, Wash., has purchased the entire electrical supply stock of T. Taylor, of Raymond, and Amann & Ellison in South Bend.

CLARENCE W. GILBERT has opened an electrical supply store on South Main Street, Washington, Ill. He will carry a complete line of fixtures, lamps, motors and general supplies.

THOMAS BURTCHALL, of Moline, Ill., was awarded the contract for the electrical work in the new Hosenstein Building in that city. The new building is to be occupied by the State Savings Bank and Trust Company, of Moline.

BAUMGARTEN & BARNES, an electrical firm at Freeport, Ill., has dissolved partnership. The business will be continued by Albert Barnes, the junior partner, while Charles Baumgarten will open up electrical salesrooms.

THE MOORE ELECTRIC COMPANY, Lexington, Ky., has secured the contract for installing the municipal lighting plant in Midway, Ky. The contract covers the entire equipment including generating station lighting construction. Series tungsten lamps will be used.

THE BERKSHIRE ELECTRIC COMPANY, Pittsfield, Mass., has received the contract for installing lighting fixtures in England Brothers' Store, which has recently been remodeled. 250-watt tungsten lamps are to be used. The installation will require a total of 400 fixtures.

THE ARROW ELECTRIC COMPANY, of Seattle, Wash., has been awarded the contract for electrical work in the Raymond Hotel Company's new building at Raymond, Wash. The Arrow Electric Company announces that it will probably establish a branch house in Raymond in the near future.

New Zealand Wireless.

The New Zealand Government has decided to erect a high-power wireless telegraph station on the Tinakori Hills near Wellington.

As previously announced, the department of QUESTIONS AND ANSWERS will hereafter be conducted in a manner somewhat different from that which has been customary heretofore. Questions relating to electrical matters of any kind are invited from our readers and will be published as soon as possible after receipt. Answers to questions are also invited from our readers and will be published in a subsequent issue. Wherever the questions or answers involve different points of view, it is hoped by this method to bring out a variety of opinions of the various matters under discussion. Answers should be received in this office not later than ten days after the date of publication of the question. Correspondents are requested to send full name and address; this, however, will not be printed except where the writer indicates his willingness therefor. Anonymous communications will not be considered.

1.—LAMP-COLORING FLUIDS.—Please tell me the formulas for the fluids used in coloring incandescent-lamp bulbs red, green, orange, blue, etc.—W. B. L., Wallingford, Conn.

2.—COUPLING OF WIRELESS CIRCUITS.—In reading a paper on wireless telephony I ran across the terms loose coupling and direct coupling, but could not make out from the text what was meant by them. Kindly explain the use of these words.—W. W. G., Chicago.

3.—ROTATION NEAR ALTERNATING-CURRENT MAGNETS.—When two metal disks, mounted on pivots so that they overlap and are free to turn, are held over the pole of a magnet excited by alternating current, the disks rotate in opposite directions. Will you explain why this rotation takes place, and why one disk is affected differently from the other?—H. C., Evanston, Ill.

4.—CHANGING GASOLINE CAR TO ELECTRIC.—Please tell me whether it would be practicable to change a single-cylinder runabout to an electric. The engine is claimed to be ten horsepower and is very noisy. The running gear and body of the car are in good condition; the chain drive could probably be used again. There is ample room under the seat for the battery. What size battery and motor would be required for a rig of this kind? What would be the cost of each and of a controller? We have a little shop and could make the change-over, if the electrical parts did not cost too much.—W. R. S., Ellsworth, Kans.

5.—PAPER INSULATION FOR TELEPHONE CABLES.—Why is paper used to insulate the wires in most telephone cables? If water enters the cable through a puncture in the sheath, does it not spread to and ground more wires than if some other insulation were used?—M. L. J., Cairo, Ill.

6.—VERTICAL AND HORIZONTAL TURBINES.—What are the relative advantages of vertical as against horizontal steam turbines for driving generators? Why are the vertical machines not made in small sizes?—R. B., Milwaukee, Wis.

7.—CHARGING IGNITION BATTERIES.—Please explain how a sparking battery can be charged from the ordinary light wires in a house, The lamps are marked 110 volts and the battery 6 volts.—G. A. T., Chadron, Neb.

8.—ELECTRICIAN IN UNITED STATES NAVY.—Can an experienced wireman become an electrician in the United States Navy without enlisting for a definite number of years?—C. E. N., Fort Wayne, Ind.

9.—LIFE OF MERCURY-RECTIFIER BULBS.—What is the average life of the special glass bulbs used in mercury-arc rectifiers? Do any manufacturers guarantee them for a certain length of time?—H. S., Chicago.

Electric Vehicle Association.

The Electric Vehicle Association of America met in New York City last Tuesday, President W. H. Blood, Jr., presiding. William P. Kennedy read a paper entitled "Administrative Engineering and Salesmanship in the Commercial-Car Field." The paper was discussed by P. D. Wagoner, S. G. Thompson, Charles Blizard, R. McA. Lloyd and others. At a meeting of the Board of Directors of the Association it was decided to hold a parade of electric vehicles during the New York Electrical Show and offer prizes. Forty-six new members were elected. Owing to a shortage of skilled workmen for electric-vehicle garages, the secretary was directed to address colleges and trade schools recommending that courses of education be established on this subject. The next meeting of the Board will take place early in September and the annual meeting of the Association will be held in New York City on October 10.

Artificial Marble for Switchboards.

It is claimed that a Berlin inventor has succeeded in making an excellent artificial marble from furnace cinders by adding a suitable cement along with coloring matter, so that he produces slabs which will serve for instrument bases or switchboard panels at a low expense. The cement does not contain resinous matter such as varnish, nor asbestos.

The process is not as yet made public, but a number of samples of the artificial marble were shown. It is stated to be extremely hard and much more so than ordinary marble. The material can be also molded in any shape so as to make various kinds of insulators. The inventor is working on a very small scale at present, but hopes to bring out the process on a commercial basis.

American Telephone & Telegraph to Do Less Construction.

The business recession during the last five or six months has caused considerable relaxation of pressure upon American Telephone subsidiaries for new construction. In his last annual statement to shareholders, President Vail said: "It is estimated that about $60,000,000 will be required for current additions to plant in 1911, of which some $30,000,000 will be provided by the existing and current resources of the companies."

This $60,000,000 estimate was an outside figure made to cover a wide variety of possible contingencies and experience of the last five months has shown that the figure will be cut under by many millions. The reduction in plant additions will not be less than $10,000,000. It may reach $15,000,000.

New Electrical and Mechanical Apparatus and Appliances.

New Ventilating Device.

For about four years the American Blower Company, Detroit, Mich., has been developing a new curved-blade disk fan, which has given high mechanical efficiencies, besides retaining every quality that should make the fan attractive to users, motor manufacturers or dealers. This new fan is called the "Ventura." It has ten broad blades of the proper dip or curve to produce large volumes freely or against pressures and so efficiently that the power consumption is said to be below the usual. Patents on the constructional features have been applied for.

The "Ventura" fan runs at speeds as high as any other fan of the disk type,

FIG. 1—VENTILATING OUTFIT.

has remarkable capacity to overcome resistances, and throws an air current straight ahead. In fact, the air as it leaves the fan has a tendency to bend inward for a considerable distance before it begins to expand. To illustrate this feature, one of these fans can be set sixteen inches away from a hole in a box and discharge more air on the other side of the opening than the fan itself handles, due to the siphon action of the air as it passes through the opening drawing in air along the face of the box.

This fan has now been incorporated in a new and unique ventilating outfit, illustrated in Fig. 1, which is designed for installation in top sashes of windows, transoms or ends of skylights. The outfit includes a 12.5-inch motor-driven "Ventura" fan; cast-iron housing; worm-geared reversing mechanism; rod; bearing and handle, and is furnished complete, ready for connection to plug or ordinary lamp socket.

Fig 2 illustrates the outfit adjusted for supplying fresh outdoor air. The ingenious reversing mechanism makes it possible to discharge the air straight ahead, upward toward the ceiling,

FIG. 2—VENTILATING DEVICE INSTALLED.

downward toward the floor, or at any intermediate location. Pure, invigorating air introduced under slight pressure, can be supplied without direct draft or directly onto occupants at will.

A simple turn of the hand wheel (Fig. 1) reverses the outfit so that it exhausts from the room, thus providing for absolute ventilation by complete air change.

Figs. 2 and 3 illustrate the simplicity of installation. To conserve the

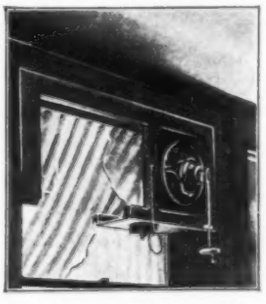


FIG. 3—GLAZED FILLER IN SASH.

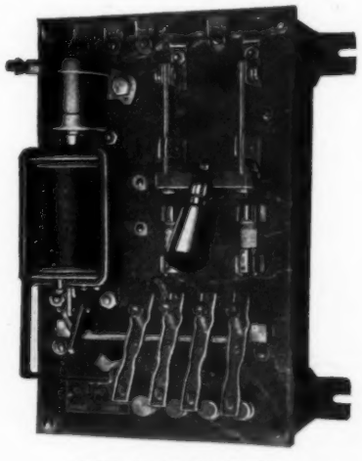
lighting effect, and add to the appearance, the filler which accommodates the ventilating set can be glazed as shown in Fig. 3. The electrical connection can be made from nearby plug or ordinary lamp socket.

The Westinghouse Electric & Manufacturing Company has received an order from the Des Moines City Railway Company for a 300-kilowatt rotary converter.

New Cutler-Hammer Self Starter.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has put on the market an entirely new type of motor self starter for use with small direct-current motors. These devices, one of which is shown in the accompanying illustration are made in capacities from one-fourth to three horsepower and are particularly adapted for the automatic or remote control of motor-driven pumps and other machinery of a similar nature.

This new "Z" type starter is operated by means of a solenoid which revolves a horizontal shaft on which four short contact arms (making butt carbon to copper contacts) are mounted. The arrangement is such that the time



NEW SELF STARTER.

of short-circuiting the rheostatic armature resistance and the acceleration can be varied. This self starter can be employed for control by float switch, push button or pressure regulator. An important feature, where used in compression-tank systems and with air or gas compressors, is the direct operation of the solenoid circuit by the pressure regulator. No relay circuit is therefore required.

These starters are particularly useful with vacuum-cleaner systems. The vacuum pumps can be started or stopped from different floors by means of push buttons connected in the solenoid circuit. These self starters are made in 110, 220 and 550-volt types, for two and three-wire control, with and without knife switch and fuses as may be desired.

An Electrically Operated Rock-Tunneling Machine.

An improved rock-tunneling machine which, it is claimed, will cut an eight-foot tunnel in rock at a rate of from 2.5 to 5 feet per hour, without dynamite, has been developed by the Terry, Tench & Proctor Tunneling Machine Company, New York, N. Y., and is being placed on the market.

The new machine is eighteen-feet long, weighs twenty-five tons, consumes about 2,000 cubic feet of free air per minute and is held in position, clamped, fed and advanced by hydraulic jacks.

The fifteen three-inch hammer drills in the new machine are mounted on a massive cast-steel revolving head with four arms somewhat like the blades of a propeller wheel. Each drill cylinder passes through the arm of the head and is very firmly held and solidly bolted in position and is supplied with compressed air at 100-pounds pressure through the main hollow horizontal shaft on which the head is mounted. This shaft is rotated by a worm wheel 3 feet 4 inches in diameter, operated by a 25-horsepower Chase air engine geared 200 to 1. The shaft and engine are carried in a main horizontal frame with front and rear vertical transverse diaphragms having sliding shoes with cylindrical surfaces engaging the faces of the tunnel.

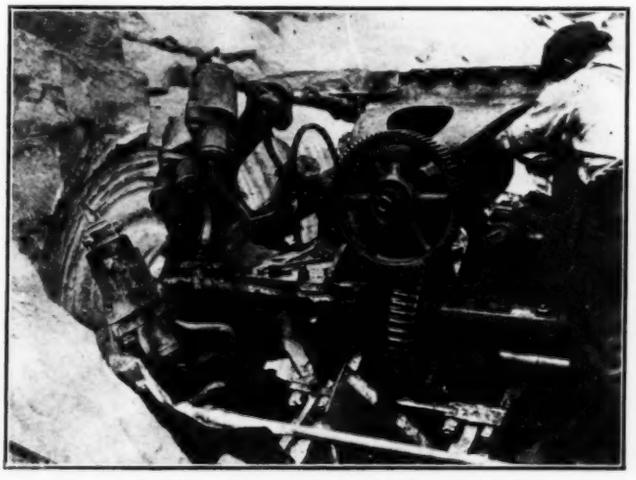
In the upper part of each diaphragm there is a pair of forty-ton Dudgeon dydraulic jacks with a stroke of eight inches, which are slightly divergent from the vertical and are operated to engage the roof of the tunnel and hold the machine firmly in position. The rear diaphragm, or spider, as it is called, can be adjusted vertically and transversely by a set of screws in the rear which determine the alinement of the tunnel.

The machine is advanced by a pair of horizontal longitudinal jacks 8 inches in diameter and of 48-inch stroke which connect the front and rear diaphragms on each side of the central shaft, and move them back and forth relative to each other. Pumps driven by a five-horsepower Westinghouse variable-speed motor, situated over the main shaft, just behind the rear diaphragm, supply pressure to all of the hydraulic jacks.

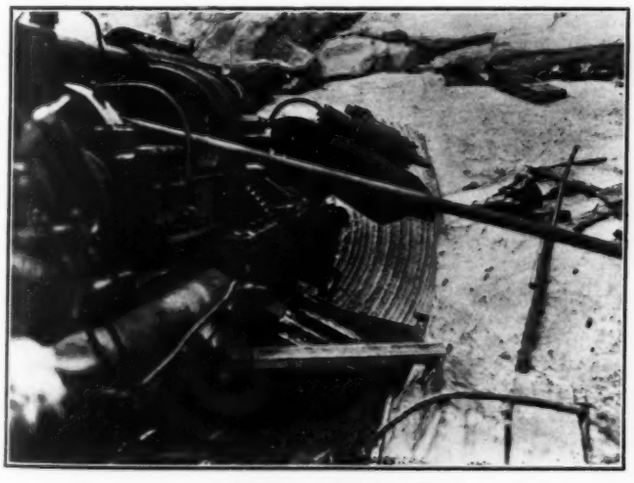
The muck is removed by a drag elevator suspended from the forward diaphragm and carried by a pair of rear wheels. It is operated by a five-horsepower Crocker-Wheeler electric motor at the extreme rear of the machine and delivers into dump cars on a track following the machine.

In one of the illustrations is shown the motor operating the hydraulic jacks. The lower motor operates a drag conveyor to convey the broken

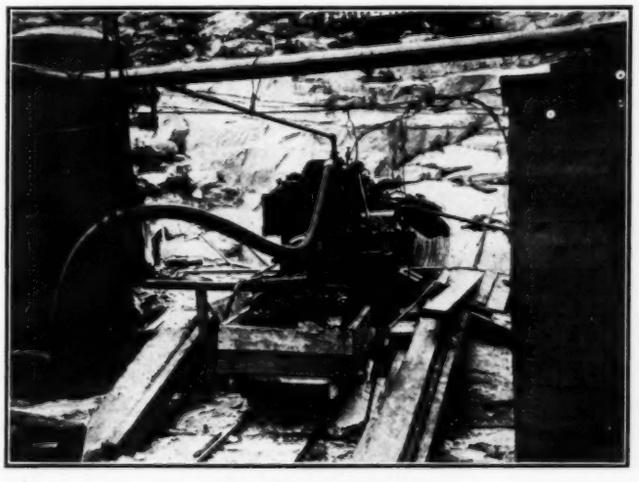
ROCK-TUNNELING MACHINE.



MECHANISM OF DRILLING APPARATUS.



BORING A TUNNEL.



MOTOR-DRIVEN PUMPS.

rock from the face of the tunnel into a car at the rear. A flexible metal hose conveys the compressed air to the hollow shaft through which it is conveyed to the rock hammers in the head.

The variable-speed motor gives complete control of the forward feed of the machine through the movement of the large hydraulic jacks, which can be moved from a fraction of an inch a minute to several inches per minute. The whole machine is automatically protected from breakage by excessive pressure by the use of safety devices. Its operation is under the control of one man.

Western Electric Company's Exhibit at Telegraphers' Convention.

What is said to be the most complete and interesting display in railway telephone and selector equipment ever shown was exhibited by the Western Electric Company at the Convention of Railway Superintendents of Telegraph held in Boston June 26-30.

This exhibit was in parlor "E" of the Hotel Brunswick, the Convention's headquarters. Here is shown a working exhibit of selector equipment as well as practically every kind of telephone apparatus used in the railway world. The No. 50-A selector and the No. 101-A and No. 102-A selector sets were in operation as well as the working exhibit of a howler.

A special board has been prepared, on which each part of the No. 50-A selector is mounted, and this is of particular interest because it allows close inspection of each piece of apparatus used in this instrument and shows the simplicity of the working parts.

Another feature of the exhibit is the long life or endurance test which the Western Electric Company has been making on its No. 58 selector. The same selector which has been put through over one and one-quarter million operations was in operation. This is equivalent to twenty-nine years of service, allowing ten calls per hour, twenty-four hours a day.

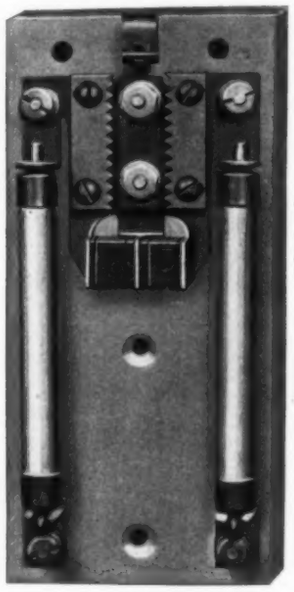
The new semaphore which has recently been developed by the Western Electric Company is also in operation. This device combines a signal and telephone system and is sure to effect great operating economies in the handling of traffic. This device should prove of interest to everyone interested in railway signaling and train dispatching.

In addition to the above apparatus mentioned there was on exhibition transmitters and receivers; transmitter arms of various types, including the new Western Electric arm, desk stands, hand sets, jacks, plugs, keys, lightning arresters, protectors, condensers, retardation coils, line poles, blocking sets, test panels, battery boxes and line material. The new Western Electric group selector is shown for the first time.

The Western Electric Company was represented by G. K. Heyer, O. D. Street, E. A. Hawkins, J. L. McQuarrie, O. E. Stephens and R. F. Spamer, of the New York house; E. V. Adams, of the Chicago office and E. L. Hawkins, W. F. Abely and H. B. Gilmore of the Boston office.

New Type of Lightning Arrester.

Telephone engineers are showing great interest in a lightning arrester which is being introduced by the L. S. Brach Supply Company, 143 Liberty Street, New York, N. Y. This arrester embodies a new electrical principal in protection and is the result of a combination of the non-air-gap lightning arrester with a standard telephone type. This combination, it is said, is a simple arrangement, and does away with dusting or fusing of the arrester after lightning storms. Instead of the arc passing across an air gap, causing the metals or carbons to fuse, the discharge is absorbed by a high-resistance block between the line and ground. The block is of a peculiar material, highly sensitive to static currents but of great ohmic resistance and of constant value. The block will not fuse and will permit no leakage of current. The air gap is not done away with as that feature is provided to allow a potential of 500 volts or over to break down and ground, thereby protecting the line from crosses with trolley wires or other high-potential circuits.



BRACH LIGHTNING ARRESTER.

The makers state that the arrangement is not an experiment as the non-air-gap arrester was introduced by the company some time ago, many thousands being now in successful service in all parts of the country on signal, telephone and telegraph lines owned by the principal railway systems.

The anti-dusting lightning arrester is built to conform with the requirements of the National Board of Fire Underwriters and every arrester is tested for efficiency. According to the makers, the capacity of discharge is very great and it is extremely more sensitive than any air-gap type as the resistance blocks themselves are capable of shunting an arc from an air gap of four mills thickness.

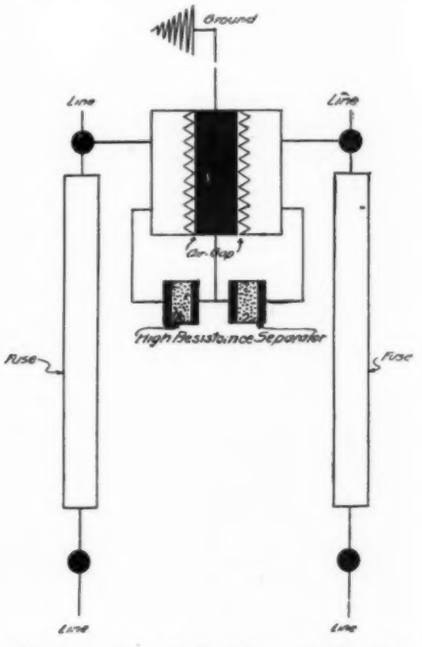


DIAGRAM OF ARRESTER. STATIC DISCHARGES PASS THROUGH HIGH-RESISTANCE SEPARATORS.

New Insulating Tape.

The D & W Fuse Company, Providence, R. I., is making a new flexible asbestos tape called "Deltatape." This is a heat-resisting insulating material which has asbestos fiber as a base. Because of this fact and the special compound used for impregnation, the tape

can be raised to a temperature of 500 degrees Fahrenheit before decomposition begins. It is said to be a good insulator electrically, although at the same time a good conductor of heat. Therefore, a coil wrapped with it, while thoroughly insulated, is not blanketed so as to make it retain heat, as is the case with most asbestos coverings.

This material is made in any width in thicknesses between 10 mils and 25 mils. The ten-mil tape requires 2,500 volts to puncture it, and 5,000 volts is required to break down the twenty-mil tape. The flexibility of this tape makes it suitable for forming around the corners and the terminals of coils. These qualities make it particularly adapted for railway motor and controller work where high temperatures and severe conditions are to be met.

INSTALLATION OF NERNST LAMPS.

The flexibility is practically permanent. "Delta" sheeting is also manufactured. This is a material 8.5 inches wide, but identified with "Deltatape" in properties, texture and finish. It is made in rolls of any convenient length and is intended for use where large pieces of insulating material are required.

Another Western Road to Dispatch Its Trains by Telephone.

The Western Electric Company has recently received an order from the Oregon-Washington Railroad & Navigation Company for telephone train-dispatching equipment for a circuit from Portland, Ore., to The Dalles, Ore., a distance of ninety miles. This circuit will be equipped with seventeen stations.

An Installation of Nernst Lamps.

John Popp, engineer with Durand & Kasper, wholesale grocers, Chicago, Ill., found it difficult to decide what kind of lamps to install in his firm's store. He determined to test several lamps with the view of helping himself in his choice. His apparatus consisted of a five-compartment wooden cabinet and was mounted on a bench. A door in the front of each compartment could be opened to permit mounting the lamp in its socket; a four-inch open space below the door made it possible to observe the effect of the various illuminants on objects placed on the bottom of the compartment. The lamps were placed equally distant from the bottoms of the compartments, about eight inches. The experiments resulted in the adoption of Nernst lamps, these showing the best results.

The complete installation for office and warehouse included thirty two-glower, 220-watt Nernst lamps and 145 single-glower, 110-watt Nernst lamps. Two arc lamps in the office were replaced by two clusters of three glowers each; this change was paid for in four months by the saving in the power bill which resulted.

The accompanying picture of office interior gives some idea of the arrangement and spacing of the lamps in this installation.

Inductive-Load Compensation of Induction Watt-Hour Meters.

The increasing use of current-consuming devices of a more or less inductive nature necessitates the employment of meters which will accurately record the energy consumption regardless of power-factor and various methods of securing this compensation have been resorted to by meter designers. One method consists of placing a short-circuited turn or secondary around the shunt-magnet pole, thus producing an induced magnetic field acting with the shunt magnetic field producing a resultant field lagging ninety degrees behind the field of the series coils.

This is the method of inductive-load compensation employed in the Sangamo Type "H" design, and meters so equipped are now supplied in all capacities. As a result the station manager can indiscriminately place meters in service without taking into account the character of load, thus avoiding selecting meters for each service as would

COMPENSATED METER.

be necessary if uncompensated meters were employed. This method of compensation is covered by Shallenberger patents of June 1, 1895, October 22, 1895, and the Sangamo Electric Company has recently completed arrangements with the Westinghouse Electric & Manufacturing Company which enables the use of this method on all Type "H" Sangamo meters.

Many engineers have a decided preference for the two single-phase-meter method of polyphase measurements instead of the more complicated polyphase meter and owing to its small dimensions the Type "H" is particularly well suited to meet this condition, as both meters can be installed side by side, occupying minimum space. The addition of inductive-load compensation in no way affects the regular adjustments of the type "H" meters, which still retain the characteristically simple light and full-load adjustments.

Holophane Data Sheets As College Text Books.

The Holophane data sheets, of which fifty-two new pages will be distributed July 1, are considered so authoritative that they are being widely used as reference books in a number of prominent institutions of learning.

Among the colleges which are making use of these data sheets as references on illumination in their engineering departments may be mentioned: University of Michigan, Armour Institute of Technology, Cornell University, Harvard University, Ohio State University, Purdue University, Yale University, University of Illinois, State University of Kentucky, Leland Stanford Junior University and Worcester Polytechnic Institute.

The installation sheets, which form a new section of the Holophane catalog, contain very complete data and the results of careful tests on actual installations. The sheets included in the present series describe a typical Childs' restaurant in New York City. Not only are all essential data included, but the results of exact photometric tests are tabulated to give the engineer the fullest possible assistance in checking the efficiency and practical utility of Holophane glassware.

Westinghouse Exhibit at Atlantic City.

At the Master Mechanics and Master Car Builders' conventions just held in Atlantic City, the Westinghouse Electric & Manufacturing Company exhibited a large line of motors and controllers especially adapted for shop and machine-tool drive. The motors included direct-current machines for general power and adjustable-speed machine-tool service, squirrel-cage alternating-current motors, slip-ring alternating-current motors and single-phase motors. The type NW slip-ring motor for elevator, crane and hoist service proved especially interesting to visitors.

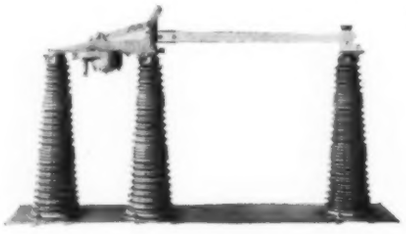
An exhibit that attracted a great deal of attention was an automatic magnetic switch controller for wheel-lathe service. The controller operates automatically, and the motor can be started, slowed down, and stopped from any point by means of push buttons. This arrangement is of special advantage in turning down wheels.

A number of domestic appliances, such as sewing-machine motors, buffing and jewelry motors, and the general utility motors were also on exhibition.

Pneumatically Operated Disconnecting Switches.

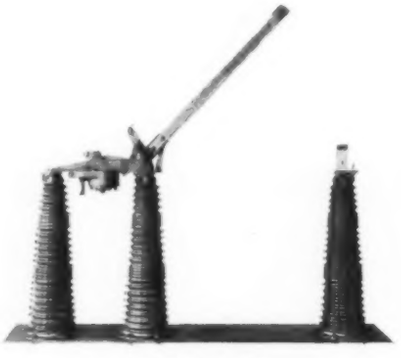
Bus isolating or disconnecting switches are usually opened or closed by means of a wooden rod, having at one end a hook to engage with the hole in the switch blade. Ordinarily this is quite satisfactory.

In many cases, however, to simplify the wiring layout, to save in length of large cables, for convenience, or for safety, it is advisable to locate the disconnecting switches in a position where they cannot be easily reached by the station operator. It is in such connection that pneumatically operated disconnecting switches find useful application.



PNEUMATICALLY OPERATED SWITCH.

The switches of this type, made by the General Electric Company, are clearly shown in the accompanying illustrations. They can be located at any height and can be controlled by an air-control valve or pull-button switch located at the switchboard or other convenient point.



SWITCH OPEN.

These switches are simple and substantial in construction, being similar to the hand-operated switches and introduce no complications in wiring. They are mounted on post-type insulators fastened to steel bases, the insulators varying in size according to the voltage.

The switches are made up in single-pole, single-throw form only, but can be opened and closed singly or any number of poles can be operated in unison. Also, one or more sets can be operated simultaneously by a single air-control valve or pull-button switch. This gives great flexibility of operation.

Pneumatically operated disconnecting switches are especially adapted for use in stations employing air-operated oil switches, but can, of course, be used in any case where an air supply is available.

When a pull-button switch is used to operate the disconnecting switch the valves in the air connections to the diaphragm are operated electrically—usually from the lighting or exciter circuit.

These switches are made in voltages from 35,000 to 110,000 and for currents of from 100 to 300 amperes.

New Power-Station Device.

Charles F. Baker, consulting engineer, formerly superintendent motive power and machinery for the Boston Elevated, also with L. B. Stillwell, consulting engineer, New York City, has been assisting for the past year C. F. Bancroft, superintendent motive power and machinery of the Boston & Northern and Old Colony Street Railway companies, in revamping, and making numerous changes in some of their power stations.

At the Quincy Point power station, where there are five 2,000-kilowatt turbo-units, and ten 650-horsepower boilers, they have made some experiments with indirect air cooling of generators. Also with a device gotten up by Mr. Baker, who says they found that his device was much more efficient and gave greater capacity to generators. He also claims a particular advantage of this device in that it is noiseless and invisible, and does not require independent driven apparatus with necessary air ducts, etc.

It was also determined by tests and experiments that by minor changes they could increase the capacity of the boilers to meet the increased capacity of the generators, which is over fifty per cent, or equivalent to 5,000 kilowatts additional. It is claimed if this 5,000 kilowatts can be produced with practically no additional cost for labor, maintenance or depreciation, and only a slight capital charge, it brings the cost per kilowatt of this additional power down to practically cost of fuel only.

Current Electrical News

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

The Public Service Commission, Second District, has closed on its records the pending complaints covering the failure of the Chasm Power Company to efficiently light the streets of the village of Chateaugay and place its street lighting and distributing system in a safe condition. Following an investigation by the Commission the company was required to make certain improvements and repairs. As the result of an investigation recently made by an inspector of the Commission he reports that these recommendations have been complied with.

The Commission has also authorized the Syracuse, Watertown & St. Lawrence River Railroad Company to construct an electric railroad from a point near Stop 9 on the Syracuse & South Bay Electric Railroad in the town of Cicero, Onondaga County, to and into the village of Brewerton, on the shore of Oneida Lake. This road is to be 6.3 miles long and is intended to accomodate residents of Syracuse and adjacent territory who desire to travel to points on Oneida Lake.

Permission has been given to the Suffern Railway Company to construct a single-track electric railroad from Orange Avenue to Lafayette Avenue in the village of Suffern, Rockland County. The company is also authorized to issue $24,000 of its common capital stock at par for cash to pay the cost of constructing such track. $5,000 of this amount is to be paid to the village of Suffern for the franchise and for paving. This will connect with the North Jersey Rapid Transit Railway at Staté Line and complete an interurban road from Paterson, N. J., to Suffern.

The Public Service Commission has received a petition from the Red Hook Light & Power Company for permission to begin construction and exercise a franchise for the distributing of electricity and gas for public and private use in the city of Hudson. This franchise was granted by the Common Council of that city on June 5, and approved by the mayor on the following day. This company has a plant in the town of Red Hook, Dutchess County, and is now distributing electricity in Red Hook, Germantown, Livingston and Clermont. For years past the city of Hudson has been supplied with electricity and gas by the Albany Southern Railway Company.

COMMISSION NEWS FROM WISCONSIN.

(Special Correspondence.)

The Commission has handed down its decision in the complaint of certain citizens of Janesville that the rate of fare charged by the Rockford & Interurban Railway Company from Janesville to the Chicago & Northwestern Railway Company yards, known as South Janesville, was excessive. The rate in force was ten cents and this fare is reduced by order of the Commission to five cents. A valuation of the physical property of the resident company in Wisconsin showed a cost new in 1909 of $369,061 and a present value of $297,518. An analysis of the income accounts of the company for the years 1909 and 1910 showed that after allowing for depreciation the company was earning about 9.98 per cent on the value of its physical property. The operating statistics of the company are carefully analyzed in the decision and the expenses and earnings are separated between the Wisconsin portion of the business and the business outside of the state. Depreciation was computed on the two-per-cent sinking fund basis. A careful apportionment of the expenses between weather and traffic costs is made in the decision.

The decision of the Commission in the matter of the application of the Red Cedar Valley Electric Company for authority to increase its rates has been recently given out. The company had in effect a rate of nine cents per kilowatt-hour for commercial lighting consumers, subject to a discount of ten per cent for prompt payment and a fifty-cent minimum monthly bill. The power rate was five cents per kilowatt-hour, subject to a discount of five per cent and a minimum bill of $1.00 per month. The company asked permission to put into force the following schedule of rates for illuminating service:

For the first 20 kilowatt-hours, 13 cents per kilowatt-hour.
For the next 30 kilowatt-hours, 11 cents per kilowatt-hour.
For the next 50 kilowatt-hours, 8 cents per kilowatt-hour.
For all over 100 kilowatt-hours, 6 cents per kilowatt-hour.
Discount 10 per cent; minimum monthly bill $1.00

POWER SERVICE.

Motors of five horsepower and over, 75 cents per horsepower, plus 2 cents per kilowatt-hour.
Motors of less than five horsepower, $1.00 per month per horsepower, plus 2 cents per kilowatt-hour.
Discount of 10 per cent, minimum bill $3.00 per month.

The company claimed a value of physical property of $87,236, while the engineering staff of the Commission found a cost new of $83,057 and a present value of $74,084. The company was found to be setting aside for depreciation five per cent on the value of the equipment and ten per cent on the distribution system. This allowance is found by the Commission to be considerably in excess of what is ordinarily allowed on such property. An allowance of three per cent on the total property was found to be about correct when computed on a straight line basis. The fact that the applicant's plant is a hydraulic plant acts to reduce the allowance for depreciation. The company was found to be earning about seven per cent on its investment. The Commission did not feel warranted in allowing any increase in the lighting rates and stated: "To what rates of return upon their investments utilities of this kind are justly entitled depends upon various circumstances concerning which reference has been made in various decisions of this Commission. These circumstances vary more or less with different localities and depend on the nature of the business and the conditions under which it is conducted. We have seen that the applicant has recently constructed a large and modern hydraulic plant and has taken over the lighting business formerly conducted by the city. In addition to this it has constructed power lines and is building up a power business. The applicant now renders all-day power and lighting service, whereas formerly only night service was given. Exclusive of the revenue from pumping, upon which the applicant cannot rely, the annual income appears to be steadily increasing. At the present time the maximum load on the hydraulic plant is much less than its capacity for generation and it appears to be possible to greatly increase the business of the company especially along power lines, without materially increasing the cost to the company. When the business of a company is new, when the plant has been recently constructed and is much larger than is necessary for present needs, the fixed expenses per unit output are usually comparatively large. Were rates, such as will return all operating expenses and a normal interest and profit, established on the costs during the early period, the income during later years, when the business of the concern has been developed to its proper level, would ordinarily result in excessive returns on the investment. In view of the fairly substantial basis upon which the applicant's business rests at this early stage of its existence there appears to be little or no ground for a modification of the rates at this time for the purpose of increasing the net income."

The Antigo Electric Company is authorized to issue $15,000 par value of five-per-cent gold bonds, to be sold for money only and at not less than seventy-five per cent of the par value. The funds derived from the sale are to be used to pay an outstanding indebtedness incurred by reason of extensions and additions made to the property of the company in Antigo, Wisconsin.

The Commission recently heard the oral arguments in the Milwaukee three-cent fare case. This concludes the taking of testimony and arguments in this case and a decision will probably be forthcoming later in the summer or in the fall.

LIGHTING AND POWER.

(Special Correspondence.)

GIBBON, NEB.—An electric light plant will be built here. C.

CANBY, MINN.—The installation of electric lights is being agitated. C.

PAULLINA, IOWA —The council has selected sites for the location of electroliers for street lighting. C.

DELAND, ILL.—I. C. Bowsher has asked the village board for a franchise to erect an electric light plant. Z.

FOND DU LAC, WIS.—Over $4,000 has been secured for the installation of an ornamental lighting system. C.

YANKTON, S. D.—The electric light plant is being remodeled to provide for a day as well as a night service. C.

SUMAS, WASH.—The town of Sumas will issue $7,000 in bonds for the construction of an electric lighting and heating system. A

EAST LYME, CONN.—A franchise has been secured by the Lyme Power Company to supply this place with electric current.

LYLE, WASH.—The Lyle Light, Power & Water Company has been incorporated with a capital of $50,000, by DeK. Dacey and G. C. Frisbie. A.

QUINCY, ILL.—Business men on East Broadway between Seventeenth and Eighteenth Streets will install ornamental lamp clusters. Z.

GALVA, ILL.—The Hayes Pump & Planter Company is installing electric power for operating its machinery and for illuminating the factory. Z.

GRAND ISLAND, NEB.—The Grand Island Electric Company

has plans for the erection of an office building and for other improvements. C.

ORANGEVILLE, ILL.—An electric light plant is being considered, and will probably be installed before winter.

NORTH BRANCH, MINN.—The Village Council granted a franchise to the Eastern Minnesota Power Company of Pine City, to operate electric lights. C.

FAIRFIELD, IOWA.—The Fairfield Gas & Electric Company has applied for a franchise to install a light and power line on the Fairfield-Birmingham road. C.

LINDSTROM, MINN.—The Minneapolis General Electric Company is considering the establishment of electric lights here and at Center City and Chicago City. C.

GUSTINE, CAL.—The Pacific Gas & Electric Company has withdrawn from this field and the San Joaquin Light and Power Company, will extend its line to Gustine. A.

WAYNESBORO, PA.—The town of Shady Grove will probably in a short time receive current for street lighting from the lines of the local street railway company.

MONTECELLO, MINN.—Chicago capitalists are planning the the construction of a large power plant and dam near here and disposing of power in Minneapolis and St. Paul. C.

ELKO, NEV.—The Board of Commissioners has granted the Deeth Mercantile Company a franchise to build and operate an electric lighting system in the town of Deeth. A.

RED LAKE FALLS, MINN.—The Red River Power Company is taking up the matter of furnishing electricity for lighting and heating to the homes of farmers in this vicinity.

MARYSVILLE, CAL.—Hetz & Berg, electricians of Marysville, have been granted permission to erect poles and string wires for an electric lighting system in Live Oak and adjacent highways. A.

OGDEN, UTAH.—The Merchants' Light & Power Company has been awarded the contract for lighting the city streets and has established offices here. The new company is capitalized at $500,000.

COLCHESTER, ILL.—The Colchester Electric Light & Power Company, whose plant recently was destroyed by fire, has been granted a tweny-year franchise and probably will rebuild the station at once. Z.

YREKA, CAL.—The Siskiyou Electric Power & Light Company is constructing a dam across the Klamath River about seven miles below Klamath Hot Springs, and will erect a large power plant at this point. A.

NEW SALEM, N. D.—The council has granted a twenty-year franchise to the Dakota Coal Products Company to supply electric light and power. The company has purchased its electrical and mining machinery. C.

BAKERSFIELD, CAL.—The San Joaquin Light and Power Company has made application for a fifty-year franchise to erect poles and wires for transmission of power along all public highways of the county. A.

YORKVILLE, ILL.—F. H. and George Simpson, who purchased the Millhurst water power site, have commenced the work of rebuilding a concrete dam. Negotiations for lighting the city of Plano are under way. Z.

EXCELSIOR, MINN.—Work has been started on the construction of the electric light and power plant. The main building will be 40 by 48 feet and a 145-horsepower Corliss engine and an 80-kilowatt generator will be installed. C.

SOUTH FORK, PA.—A charter has been granted to the Croyle Township Light, Heat & Power Company. The capital of the company is $5,000 and the incorporators are J. W. Stineman, O. M. Stineman, and A. M. Stineman, all of South Fork.

BLOOMINGTON, ILL.—Since the inauguration of the first cluster lighting system in Bloomington, petitions have been circulated asking for ornamental systems on South Main Street, Center Street, Washington, Jefferson, Front and Madison Streets. Z.

NASHVILLE, TENN.—Secretary of State Hallum W. Goodloe has issued a charter to the Lunda Light Company, Shelby County. The new concern is capitalized at $50,000. Incorporators: P. F. Lunda, N. W. Lunda, W. L. Fisher, N. J. Verret and T. W. Morris. I.

FAYETTEVILLE, TENN.—A charter has been granted to the Petersburg Electric Light & Power Company, which was recently incorporated to light the town of Petersburg. The incorporators are A. C. Davis, George McAdams, J. A. Montgomery, C. McRady and O. F. Gill.

DALTON, GA.—The Board of County Commissioners has granted the East Tennessee River Power Company the right to build and repair towers for their transmission lines through this county, giving them also the right to sell electrical power here. The right extends for fifty years.

HILLSBORO, ILL.—The contract for the erection of the new power plant for the Hillsboro Electric Light & Power Company was let to J. T. Morgan and Frare Brothers of Hillsboro. The company also has bought two 327-horsepower boilers and one turbine engine of 1,000-horsepower capacity. Z.

NORTH TROY, VT.—The Frontier Electric Company, which will supply electric power to the county of Orleans and elsewhere in Vermont and Quebec, has been incorporated with a capital stock of $30,000. Everett Forsyth, C. S. Emery, A. H. Butterfly, A. H. Bailey and G. N. Bailey are interested.

NEVADA, PA.—The Nevada Electric Company of this city is considering the proposition of running lines to Roland, McCallsburg, and Zearing, to supply those towns with current for light and power uses. A twenty-four-hour service will probably be given. Roland has already voted $8,000 to be used in providing light.

MARION, PA.—A new street lighting system has been installed in Marion Heights borough by the Edison Electric Illuminating Company of Mt. Carmel, which now furnishes electricity at that place. Twenty-six lights have been placed at various street intersections. The posts carry sixty-candlepower tungsten lamps, equipped with special reflectors.

MINONK, ILL.—The directors of the Union Light & Power Company recently formed by a merger of the electric light companies at Minonk and Rutland have elected the following officers: President, S. C. Kipp, Minonk; secretary, F. Z. Ames, Rutland; and treasurer, J. S. Webber, Rutland. The Toluca light plant has been purchased from W. W. Twist and the three plants will be operated by one concern with a capital stock of $100,000. Z.

FORT DODGE, IOWA.—The Northern Iowa Power Company has let a $178,000 contract for the construction of a concrete dam and auxiliary steam power for an electric generating plant. The hydroelectric plant will develop 2,000 horsepower and the steam plant 750 horsepower. The total cost of installing the generating plant will be close to $200,000. W. W. Stearns, of Humboldt, and his son, D. M. Stearns, are behind the project.

MT. PLEASANT, IOWA.—Three dams are being built along the Skunk River, and hydroelectric power will be supplied to a large area when the plants under way are completed. When the plants are in service a circuit will be established which will take in Burlington, Mount Pleasant, Wapello and other towns. A steam plant will be built here to supplement the water power in case of accident to any of the stations and for use in times of low water.

PUEBLO, COLO.—The property of the Pueblo & Suburban Traction & Lighting Company and allied interests in Colorado, were taken over June 14 by H. M. Byllesby & Company, of Chicago. The Pueblo & Suburban Traction & Lighting Company operates the street railway system of Pueblo and supplies electricity to Pueblo and the Cripple Creek gold mining district, including the cities of Cripple Creek, Victor and Goldfield. The towns of La Junta, and Rockyford are served with electricity by subsidiary corporations. A steam-electric power station of 4,135 kilowatts at Pueblo and a hydraulic power plant of 1,600 kilowatts at Skaguay are operated. Arrangements are being made to increase the capacity of the steam station at Pueblo and to extend transmission lines to serve additional cities and towns. Additional hydroelectric developments also are contemplated. W. F. Raber is at present in charge of management for Byllesby & Company.

ELECTRIC RAILWAYS.

(Special Correspondence.)

BEMIDJI, MINN.—There is an agitation for the construction of an electric railway around Lake Bemidji. C.

SIOUX FALLS, S. D.—The Sioux Falls & Southern Minnesota Traction Company has been incorporated.

MANKATO, MINN.—The street-railway company will shortly commence the extension of its line down Willard Street. C.

ST. CLOUD, MINN.—Work has been started on the extension of the street-car line to the Sauk River from Waite Park. C.

WAUSAU, WIS.—The Wausau Street Railroad Company has been granted permission to lay double tracks on Forest Street. C.

WORTHINGTON, MINN.—Knight & Doyle, promoters of the new electric line to Sioux Falls, are about to commence the survey for it. C.

PINE ISLAND, MINN.—The Interurban Construction Company has applied for a franchise to build an electric railway along Main Street. C.

SANTA MONICA, CAL.—The municipality will sell, on July 10, a forty-year franchise for a street railway on certain streets in Santa Monica. A.

WEST BRANCH, IOWA.—The Commercial Club is trying to secure the construction of the Davenport-Iowa City interurban line through the city. C.

OLNEY, ILL.—The Mt. Carmel, Lancaster & Olney Traction Company's line will be finished to Lancaster this summer and then extended to Olney. Z.

FORT DODGE, IOWA.—The Fort Dodge, Des Moines & Southern interurban has commenced work on the Lehigh line. A telephone line will also be built. C.

SUN PRAIRIE, WIS.—The Milwaukee Western Electric Railways Company proposes to construct its lines from Milwaukee to Green Lake through this village. C.

ROCK ISLAND, ILL.—The original franchise of the Rock Island-Galesburg Company has been extended thirty-five years from

July 1, 1911 and the specified time for building has been extended to November 1, 1912. Z.

ABERDEEN, S. D.—The street railway company announces that it will move its barns and terminals off the track and will reconstruct and materially enlarge them. C.

DULUTH, MINN.—The Suburban Railway Company promoted by N. J. Upham, will shortly commence the construction of a line to connect with the Brooks-Scanlan railway. C.

ANOKA, MINN.—The Atlas Engineering Construction Company has commenced the construction of the road of the Minneapolis, Northern Suburban Railway Company. C.

LOS ANGELES, CAL.—The Los Angeles Pacific Railway Company has requested permission to electrify the old Santo Monica steam line of the Southern Pacific to the west city limit. A.

OAKLAND, CAL.—The Oakland and Bay Shore Railroad Company has been granted a thirty-five-year franchise for a standard-gauge track along certain streets in the City of Oakland. A.

WATERLOO, IOWA.—Shady Grove, Jubilee and Gilbertsville are offering inducements to secure the new south extension of the road to be built by the Waterloo, Cedar Falls & Northern. C.

CHICO, CAL.—The Northern Electric Company has been granted a fifty-year franchise for a double track on Main Street, Chico, Cal. The company will surrender the old franchise. A.

ONAWA, IOWA.—An effort will be made to secure the construction of the interurban line from Omaha to Sioux City by the Omaha & Western Iowa Traction Company through this city. C.

EAST ST. LOUIS, ILL.—The Alton & Southern Traction Company has asked for a franchise to use certain streets in the city and to connect with the tracks of the St. Louis and Belleville Electric Railway. Z.

MUSCATINE, IOWA.—Contract for the construction of the Muscatine-Davenport interurban railway has been let to Yale & Reagan of Chicago. Work will begin between Blue Grass and Sweetland and plans call for the operation of cars by December 1. Z.

WEBSTER CITY, IOWA.—The Fort Dodge, Des Moines & Southern interurban has made a proposition to furnish the city with electricity from its plant at Fraser. The company is also trying to secure a francnise for an electric street railway. C.

DIXON, ILL.—Committees from the Chambers of Commerce in Dixon, Oregon and Rockford are agitating an electric interurban line from Dixon to Rockford. The proposed route touches Grand Detour and a number of other northern Illinois summer resorts. Z.

KOKOMO, IND.—W. H. Shott & Company have been awarded the contract for the construction of a traction line for the Kokomo, Frankfort & Western Traction Company, the work to begin July 1 and cars to be running by January 1. The new line will parallel the Clover Leaf road. Z.

LOS ANGELES, CAL.—Surveys are being made and material assembled for an electric railway to be built between the Los Angeles and Redondo-Moneta Avenue line and the Long Beach line of the Pacific Electric. Work will be pushed and the line placed in operation before the end of summer.

ST. LOUIS, MO.—Bonds of the St. Louis, Arcadia & Jefferson City Railway Company to the amount of $10,000 have been voted to insure the carrying out of the company's franchise agreements. The company proposes to construct an electric railway from Arsenal Street, in St. Louis, to Arcadia, Mo. T. G. Portis, Charles F. Vogel and E. R. Kinsey are the promoters of the proposed electric line.

MT. VERNON, ILL.—The Southern Traction Company which was given a franchise to operate electric cars over the upper deck of the municipal free bridge at St. Louis has purchased the Wabash, Chester & Western Railroad, sity-five miles long, from Chester to Mt. Vernon and will electrify it. A connecting line forty miles long will be necessary to link it with the route of the proposed Southern Traction Company. Z.

CHICAGO, ILL.—The Indianapolis-Chicago Meridian Railway was incorporated in Indianapolis, Ind., and the electric line is to pass through Sheridan, Flora, Monticello, Francisville, Kouts, Valparaiso, Hobart, Wheeler, Gary, Hammond, Fort Wayne, Columbia City and Warsaw. It is capitalized for $100,000. The incorporators are John C. Bilheimer, John A. Schaffer, M. J. Moreland, Hoover Holton and M. B. Keller.

CEDAR RAPIDS, IOWA.—Announcement has been made that Col. W. G. Dows, Isaac B. Smith and John A. Reed, principal stockholders in the Cedar Rapids & Iowa City Interurban and local electric light company, have purchased the power plant at Boone of the Boone Light, Heat & Power Company, the Boone street railway and the Boone interurban railway system. The new company will furnish power for the Northwestern shops which are being built at Boone at a cost of $1,000,000.

KANSAS CITY, MO.—Work will be started in a short time on the construction work of the street railway lines into North Kansas City. At the northern end of the tract known as North Kansas City the Townsend-Arnold syndicate will build a line to St. Joseph and use the Union Depot Company's tracks over its holdings. A second street car line is to cross North Kansas City in another part and from the end of this line the Townsend-Arnold Company will build its Excelsior Springs line.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

TRUMBULL, NEB.—A new exchange is being built for the telephone company. C.

SHABBONA, ILL.—The Exchange Telephone Company has been granted a franchise to use the streets of the village. Z.

KELLOGG, MINN.—The Greenfield Farmers' Telephone Company, capital $10,000, has been incorporated, with headquarters in this town. C.

NAPA, CAL.—W. M. Lyons has made application for a fifty-year franchise for a telephone line along all public roads of Napa County, Cal.

CAREY, IDAHO.—The Carey Telephone Company has been incorporated here by E. W. Fox, J. R. Adamson, T. B. Evans, C. C. Shelter and T. C. Stanford.

LA VALLE, WIS.—The La Valle Telephone Company has been incorporated with a capital of $15,000. Incorporators are S. A. Towne, Edmund Tordorff, Elmer Gardner.

COUNCIL HILL, OKLA.—The Farmers' Telephone Company has been incorporated with a capital of $3,000. The incorporators are R. L. McCoy, J. F. Sanders and W. H. Standley.

HOMER, ILL.—The Douglas County Telephone Company will build a new line from Homer by way of Sidney to Champaign. A direct line is also being built from Homer to Danville. Z.

UKIAH, CAL.—The Willits & Laytonville Telephone & Telegraph Company has obtained permission to put in a telephone line along the county road from Long Valley to Willits, Cal.

ODIN, ILL.—The Odin Telephone Exchange Company was recently incorporated with a capital of $15,000. The incorporators are J. D. Dace, W. H. Farthing, L. Somerville and C. E. Sloan.

ROCKFORD, ILL.—The Northwestern Telephone & Telegraph Company has been granted a charter with capital stock of $30,000. The incorporators are George P. Callsher, James H. Rush and George J. King. Z.

BATAVIA, ILL.—The Inter-State Telephone Company is rebuilding its line from Batavia to Geneva. The line is also used by the county for a power-transmission line to the county almshouse and the cost will be shared. Z.

WYOMING, ILL.—The Stark County Telephone Company has taken over the business of the Duncan Telephone Company which has been operating 150 phones in and around Duncan. This now gives the Stark Company 1,600 phones with exchanges at Wyoming, Toulon, Elmira, Camp Grove, Castleton and Duncan. Z.

ELECTRICAL SECURITIES.

Northwestern Elevated stockholders' special meeting has been called for 11 a. m. Monday, August 1, to authorize a $25,000,000 bond issue. Books close August 10 to 22.

Stone & Webster are offering $350,000 Electric Corporation six per cent cumulative first preferred stock at 92.5, yielding 6.5 per cent.

E. H. Rollins & Sons, New York City, are offering $1,000,000 Southern California Edison Company six per cent five-year gold debentures at 101 and interest to yield 5.75 per cent.

The United Railways & Electric Company, of Baltimore, will hold a special meeting July 3 to consider a resolution for the issue and sale when authorized of $3,125,000 three-year collateral five per cent coupon notes convertible into common stock at $25 per share. Proceeds will be used to retire $2,500,000 obligations of the Baltimore City Passenger Railway Company, maturing November 2, 1911, and $535,000 car trust certificates, series B and C outstanding after October 1, 1911.

At a recent meeting of the board of directors of the United States Light & Heating Company the matter of increasing the par value of the common and preferred stocks of the company from $10 to $100 was discussed and referred to a committee to consider the matter and report to the full board later on. If the change in par value is approved by the board of directors and authorized by stockholders, application will probably be made to list the common and preferred stocks on the New York Stock Exchange.

The New England Telephone & Telegraph Company has declared a quarterly dividend of one and three-quarters per cent, an increase of one-quarter of one per cent quarterly. President Keller, in making announcement of the increase in the dividend, said: "The average dividend during the life of the company has been less than five per cent. Although the company has been for several years in position to change its dividend rate, action was deferred until completion of recent readjustments. It is now practically certain that these will reduce net revenue between $500,000 and $600,000 per year, and recent wage increases will absorb over $200,000 more. It is expected that additional business as result of lower rates will in another year begin to make itself felt, and insure a fair margin of safety over charges."

The annual meeting of the stockholders of the Westinghouse Electric & Manufacturing Company will be held at the chief office of the company, at East Pittsburg, Pa., on Wednesday, July 26, 1911, for the election of directors, and for the transaction of such other business as may properly come before the meeting. All of the former non-assenting stock of the company having been ex-

changed for assenting stock, which now constitutes the only class of the stock of the company now outstanding other than preferred stock, a resolution will be considered and acted upon that the assenting stock be hereafter denominated common stock. The stock transfer books will be closed on July 15, 1911, at noon, and opened on July 27, 1911, at ten o'clock a. m.

DIVIDENDS.

American Power & Light Company; regular quarterly dividend of one and one-half per cent on the preferred stock, payable July 1.

American Telephone & Telegraph Company; quarterly dividend of two per cent, payable July 15.

Carolina Power & Light Company; quarterly dividend of one and three-quarters per cent, payable July 3.

Central & South American Telegraph Company; quarterly dividend of one and one-half per cent, payable July 8.

Cities Service Company; regular monthly dividends of one-half of one per cent on the preferred stock and one-quarter of one per cent on the common stock, payable July 1.

Electric Storage Battery Company; regular quarterly dividends of one per cent on the common and one per cent on the preferred, payable July 1.

Little Rock (Ark.) Railway & Electric Company; regular semi-annual dividend of four per cent and an extra dividend of one per cent on the common stock, payable July 1.

Nashville Railway & Light Company; quarterly dividend of one per cent on its common stock and the usual one and one-quarter per cent quarterly dividend on its preferred stock, payable July 1. The previous quarterly disbursement on the common stock was three-quarters of one per cent.

New England Telephone & Telegraph Company; quarterly dividend of one and three-quarters per cent. This is an increase of one-quarter of one per cent over the previous payment, which was made on March 31 last, and places the issue on a seven per cent per annum basis.

New Orleans Railway & Light Company; regular quarterly dividend of one and one-quarter per cent on the preferred stock, payable July 15.

Pacific Coast Power Company; semi-annual preferred dividend of $3 per share; semi-annual common dividend of $2.50 per share, and an extra common dividend of fifty cents per share, all payable July 17.

Philadelphia Company; regular quarterly dividend of one and one-half per cent on the common stock, payable to stockholders of record July 1; also an extra dividend of one-half of one per cent on the common stock, payable August 1, and an extra dividend of one-half of one per cent, payable November 1, to stockholders of record October 2.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	June 26.	June 19.
Allis-Chalmers common	8½	8⅜
Allis-Chalmers preferred	29	30¾
Amalgamated Copper	71⅛	71
American Tel. & Cable	78	80
American Tel. & Tel.	149¼	151⅜
Brooklyn Rapid Transit	80⅜	80
General Electric	163½	161½
Interborough-Metropolitan common	18	18¼
Interborough-Metropolitan preferred	51	52⅜
Kings County Electric	129	129
Mackay Companies (Postal Telegraph and Cables) common	89	89½
Mackay Companeis (Postal Telegraph and Cables) preferred	74⅛	74½
Manhattan Elevated	134	136½
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
U. S. Steel common	79¾	50¼
U. S. Steel preferred	118½	108⅜
Western Union	79⅝	79¾
Westinghouse common	76½	74½
Westinghouse preferred	*118	*110

BOSTON.

	June 26.	June 19.
American Tel. & Tel.	149⅛	151¼
Edison Elec. Illuminating	284	285
General Electric	164	163
Massachusetts Electric common	22½	22⅜
Massachusetts Electric preferred	91½	91¾
New England Telephone (ex dividend)	146	149
Western Tel. & Tel. common	18¾	19
Western Tel. & Tel. preferred	96½	96½

PHILADELPHIA.

	June 26.	June 19.
American Railways	43¾	43⅞
Electric Company of America	12	12
Electric Storage Battery common (ex dividend)	54⅛	56
Electric Storage Battery preferred (ex dividend)	54¼	56
Philadelphia Electric	17¼	16⅞
Philadelphia Rapid Transit	19	19¾
Philadelphia Traction	86¾	87¼
Union Traction	49	49½

CHICAGO.

	June 26.	June 19.
Chicago Railways, Series 1	80	80
Chicago Railways, Series 2	20½	20¾
Chicago Subway	3¾	3¾
Chicago Telephone	124	122
Commonwealth Edison	129	128½
Metropolitan Elevated common	26½	25¼
Metropolitan Elevated preferred	73½	71¼

PERSONAL MENTION.

S. Z. DE FERRANTI was re-elected president of the London Institution of Electrical Engineers, at the annual meeting which was held recently.

RALPH MODJESKI, a member of the faculty of the University of Illinois, has received the title of Doctor of Engineering. The degree was conferred at the recent commencement exercises at Urbana.

PROFESSOR WOLDENBURG, of Charlottenburg, Germany, has been appointed to the new chair of machine design which was created in the engineering department of the University of Michigan.

W. O. DUNTLEY, president of the Chicago Pneumatic Tool Company, sailed for Europe June 27, on the *Kronprinzessin Cecile*. Mr. Duntley will inspect the foreign subsidiaries of his company while abroad.

W. P. KENNEDY presented a paper before the Electric Vehicle Association of America, June 27, on the subject, "Administrative Engineering and Salesmanship in the Commercial Field." Mr. Kennedy spoke on the same subject before the Engineers' Association Convention at Dayton, O.

R. L. NOGGLE, formerly superintendent for the Northern Idaho & Montana Power Company at Sandpoint, Idaho, has resigned to accept a position with the Pacific Power & Light Company of Portland, Ore. Mr. Noggle will be superintendent of construction for this company, with headquarters at Walla Walla, Wash.

ALTEN S. MILLER, president of the Union Electric Light & Power Company, of St. Louis, Mo., was, on leaving that company, given two banquets by the local electrical bodies with which he was affiliated. The first of these, given at Forest Park Highlands, was held on June 23. The second was given by the St. Louis League of Electrical Interests, at the Hamilton Hotel, on June 27. At the first mentioned of these banquets an album giving historical features in connection with the company was presented to Mr. Miller by John Hunter, on behalf of the department heads. The banquet table was elaborately decorated with flowers, and at the head of the table directly before Mr. Miller appeared an immense bouquet of American Beauty roses, which were sent to Mrs. Miller at her home, reaching her while the banquet was taking place. Mr. Miller joins Prof. A. C. Humphreys in New York on July 1, to assist him in his consulting engineering work.

R. B. BRINSMADE, until recently professor of engineering in West Virginia University, has issued a statement showing that his dismissal in January last was due entirely to political reasons and to differences in economic opinions between him and the governor of the state. In commenting upon the case, the Morgantown *Post-Chronicle* said: "The personal injustice that has been wrought in the case of Professor Brinsmade and in other cases is a small matter in comparison with the injury that has been done to the University itself and the loss of its efficiency in the educational economy of the state. No institution can be a fit place for the education of young Americans in which there is even a suspicion that the men of the teaching force are talking through political muzzles, that they are of an emasculated type of citizenship, incapable of taking a virile part in the practical affairs of government, afraid to speak the truth as they believe it in their hearts."

NEW PUBLICATIONS.

WASHINGTON ACADEMY OF SCIENCES.—Beginning on July 15, the Washington Academy of Sciences will issue a journal which will appear semi-monthly when the present *Proceedings* will be discontinued. The new journal will be a medium for the publication of original papers on the scientific work done in Washington, also abstracts of current scientific literature and current notes connected with scientific life in Washington. The subscription will be $6.00 per annum, but the journal will be sent to members of the Academy free.

INTERNATIONAL CABLE DIRECTORY.—The International Cable Directory Company, 59 Pearl Street, New York, has just issued the fourteenth annual edition of the International Cable Directory of the World, in conjunction with the Western Union telegraphic code. The contents of the directory are listed in English, German, French and Spanish. The book is recognized as a standard reference one by the State Department of the United States Government, and is to be found in all embassies, legations and consulates for the use of the public.

AN AMERICAN CONSUL IN AMAZONIA—William Edwin Rudge, of New York, has issued "An American Consul in Amazonia," written by Maj. J. Orton Kerbey. The author's desire has been to give a truthful record of actual occurrences in the career of a consul some years ago, by comparison with conditions found during recent re-visits, and especially to call attention to the consul's original investigations of the rubber industry through official reports and subsequent researches. It has also been endeavored to tell something of the present social and intellectual conditions existing in the cities and of the encouragement of the independent missionary effort now being inaugurated among the youths of Brazil in the way of college and school associations with the United States. The book is dedicated to Andrew Carnegie, Major Kerbey's first instructor in the telegraph business, and he also expresses his

obligations to David Homer Bates, the author of "Lincoln in the Telegraph Office." There are many fine illustrations.

DEVELOPMENT OF THE UNITED STATES.—The Statistical Record of the Development of the United States, which was first published by the Bureau of Statistics thirty-three years ago. This annual publication, originating with the Bureau of Statistics thirty-three years ago, then a small volume of 150 octavo pages, has grown with the growth of the country and the demands of the public for additional information, to 750 pages in this, the thirty-third number just issued. Pure statistical, and thus appealing only to those desiring definite information in concrete form, it presents many interesting pictures of conditions past and present in the United States. The forty pages devoted to internal communication and transportation include data on the postal service, telegraph statistics, miles of railways operated, length of track, number of persons and tons of freight carried, showing a growth of railways operated in the United States from 30,500 miles in 1860 to 53,000 in 1870, 93,000 in 1880, 167,000 in 1890, 199,000 in 1900, and 250,000 in 1910. Data regarding express companies; transportation upon the lakes and principal rivers of the country; freight rates from principal interior points to the coast, and to European ports are also shown.

NEW INCORPORATIONS.

ALBANY, N. Y.—The Electric Omnibus Corporation has been incorporated for manufacturing electrical omnibuses, by A. J. Parker, Jr.

NEW YORK, N. Y.—The Peerless Engineering Company, with a capital of $10,000, has been incorporated by E. P. DeTurk, George R. Lee and C. F. Russler.

NEW YORK, N. Y.—Induction Signal and Safety Stop Company, with a capital of $25,000, has been incorporated by Webster Bishop, for the manufacture of electrical signals, etc.

CHICAGO, ILL.—Moran & MacNair recently incorporated with a capital stock of $5,000 to do electrical construction work. The incorporators are Jerome J. Cermak, Roy J. Barnett and Leo Klein.

NEW YORK, N. Y.—The Porsth Electric Company has been incorporated, for conducting an electric contracting business, by Robert E. Denicke, Arthur L. Semel, and Emile Pincus. The capital is $25,000.

MANHATTAN, N. Y.—The Berg Storage Battery Car Company was recently incorporated by Iselin & Delafield and others, to manufacture railway cars operated by storage batteries. The capital of the company is $110,000.

MANHATTAN, N. Y.—The Superior Storage Battery Company have incorporated with a capital of $25,000 to manufacture electric storage batteries. The incorporators are Henry Bonawitz, Rudolph Drawbourg, and Vernon J. Miller.

MANHATTAN, N. Y.—The B. A. B. Model & Manufacturing Company has been incorporated with a capital of $10,000, by E. J. Glennon, Arthur J. Brown, Anthony Brown and Thomas R. Atkinson. The company will manufacture electrical models, machinery, etc.

KOKOMO, IND.—The Electric Welding Company has filed articles of incorporation to manufacture machines for the purpose of doing electric welding of all kinds of metal and for the equipment of manufacturing plants. The directors are Jesse Jackson, F. M. Ruddell and Conrad Wolf. S.

PROPOSALS.

POST OFFICE, ALPENA, MICH.—The Supervising Architect, Washington, D. C., will receive, until July 21 bids for the construction complete including electric conduits, wiring, lighting fixtures and heating apparatus, of a United States Post Office. Copies of the drawings and specifications may be had at the office of the Supervising Architect or from the custodian at the site.

POST OFFICE, CLEBURNE, TEX.—The Supervising Architect, Washington, D. C., will receive sealed bids, until July 25 for the construction including heating apparatus electric conduits, wiring and lighting fixtures, for a United States Post Office. Copies of the drawings and specifications may be obtained at the office of the Supervising Architect or from the custodian at the site.

POST OFFICE, BRISTOL, CONN.—The Supervising Architect, Washington, D. C., will receive sealed bids, until July 24, for the construction, including heating apparatus, electric conduits, wiring and lighting fixtures, for a United States Post Office. Copies of the drawings and specifications may be obtained at the office of the Supervising Architect or from the custodian at the site.

NAVY DEPARTMENT SUPPLIES.—The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will open bids on naval supplies on the dates given below. Bidders interested therein should make early application for copies of the schedule, giving the schedule number desired. Schedules can be obtained from the Navy Pay Office nearest each navy yard. Bids will be asked on the following supplies:

Date of Opening.	Material.	Quantity.	Place of Delivery.	Schedule No.
July 11—	Boxes, fire alarm, etc..	Miscellaneous.....	Washington, D. C.	3722
	Cells, dry	900.....	Brooklyn, N. Y.	3728
	Fuses, electrical	Miscellaneous.....	Brooklyn, N. Y.	3728
	Fuses, glass tube	25,000.....	Norfolk, Va.	3728

INDUSTRIAL ITEMS.

ROESSLER & HASSLACHER CHEMICAL COMPANY, New York, N. Y., calls attention in its last price list to its new active-oxygen products.

FEDERAL SIGN SYSTEM (ELECTRIC), has mailed novel cards, to which are attached samples of the Federal lock-clamp bushings. The clamping ring is made of non-rusting metal and a high grade quality of porcelain is used.

H. W. JOHNS-MANVILLE COMPANY, Cleveland, O., takes up, in the June issue of its house organ, the *J-M Packing Expert*, the development of the steamers on the Great Lakes. Illustrations of the earlier and later types are included.

THE DUPLEX METALS COMPANY, Chester, Pa., has issued a folder in which the statement is made that No. 9 B & S, special-grade copper-clad, costs less per mile than No. 6 E. B. B. galvanized, and gives almost the same conductivity as the new galvanized.

THE FEDERAL SIGN SYSTEM (ELECTRIC), Chicago, Ill., describes the Federal vacuum cleaner and Federal rotary pump used in connection with this in the June number of its publication, *The Federalist*. Federal clusters and other specialties are also illustrated.

THE UNITED ELECTRIC COMPANY, Canton, O., is mailing folders urging the installation of large pipes in the installation of any air-cleaning system. The five sizes of Tulc machines illustrated give an excellent idea of the appearance of the stationary air cleaners manufactured by the company.

HUMPHREYS & MILLER, INC., started in business on July 1, when Alten S. Miller was taken into the firm formerly known as Humphreys & Glasgow, Inc. The firm, of which Mr. Miller will be vice-president, will be prepared to advise in the purchase, construction, rehabilitation and operation of natural and artificial gas and electric properties, making complete reports on them.

THE MESTA MACHINE COMPANY, Pittsburg, Pa., has distributed an attractive bulletin on its steam-hydraulic quick-acting forging and bending process. The company has the exclusive right for building the Haniel and Lueg forging presses in the United States and Canada. These presses are used by the Krupp Works in Germany and most of the other large forging plants in Europe.

THE GENERAL VEHICLE COMPANY, New York, N. Y., has received from the Bureau of Insular Affairs an order for fifteen large trucks for service in the Philippines. This is the fourth order for trucks for that locality and is regarded as an especially complimentary testimonial. The trucks are to be used principally in the ice and refrigerating enterprises of the government at Manila.

THE LINDSLEY BROTHERS COMPANY, Spokane, Wash., has mailed its illustrated catalog taking up the history of the Western pole industry, and including the official specifications as prepared by the Idaho Cedarmen's Association. The catalog also covers inspection comments and gives complete information regarding cross-arms, and a table for the use of inspectors. Copies of the booklet may be had by writing to the company at the Spokane office.

THE OHIO BRASS COMPANY, Mansfield, O., include in the last issue of the *O. B. Bulletin*, a description of the Rock Island & Southern Railway's 11,000-volt single-phase catenary-construction trolley lines. This road connects Rock Island and Monmouth, Ill., a distance of 50.2 miles. The catenary overhead system was designed by the Ohio Brass Company, and their material used throughout. Illustrations of several features of the line have been included with the description.

THE IDEAL ELECTRIC & MANUFACTURING COMPANY, of Mansfield, O., announces that it has opened a New York office at 50 Church Street, New York. This office will be in charge of H. J. Brewer, who has complete information, prices, specifications, etc., on the Ideal electrical apparatus. The new line of apparatus comprises standard frames, alternating-current and direct-current motors and generators, high-torque squirrel-cage motors, interpole motors, and a new design of electroplating dynamos.

THE PITTSBURGH TRANSFORMER COMPANY, Pittsburgh, Pa., has recently issued bulletins No. 1151 and 1152, the first taking up the subject of the new line of small low-voltage transformers, and the second listing bell-ringers. The wide use of electric signs using low voltage lamps and the extension of low-voltage lamps in train lighting has become so important that this line of transformers with low core and copper losses has been developed. The two sizes of bell-ringers listed in bulletin No. 1152 have three low voltages.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has received from the Northern Contracting Company, of New York City, an order for electrical apparatus for the Tallulah Falls development of the Georgia Power Company. This order includes three 10,000-kilowatt waterwheel-driven generators, three 100-kilowatt direct-connected exciters, nine 3,333-kilowatt transformers, and a switchboard. Electric power at a potential of 110,000 volts will be transmitted to Atlanta for distribution in that city and vicinity. The development is planned for 60,000-kilowatt.

THE NATIONAL ELECTRIC LAMP ASSOCIATION has issued

two bulletins, one entitled "Economical Operation of Incandescent Lamps" and the other "Mazda Incandescent Street Lighting." The first of these gives a detailed technical discussion of the principles involved and the methods to be used in determining conditions of most economical operation for incandescent lamps, from the standpoint of both consumer and central station. The text is elucidated by numerous curves and tables. The bulletin on street lighting is a revision of a former bulletin on this subject and gives distribution curves for some of the latest types of reflectors.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis, recently distributed bulletin No. 1523, describing portable and stationary air compressors for industrial purposes. This bulletin gives a general description of photographs of this type of apparatus, together with tables containing data relative to sizes, capacities, weights, etc. This type of compressor has found much favor in industrial plants. bulletin No. 1081, issued at the same time, contains a very complete description of polyphase induction motors of Type "AN" and "ANY," together with photographs showing the details and applications of these motors. A list of ratings is also included.

THE OTIS ELEVATOR COMPANY, New York, N. Y., distributed at the recent convention of the National Electric Light Association, a pamphlet on Otis alternating-current elevators. The demand for this kind of equipment is steadily increasing and installations are being made throughout the United States. A number of special forms of control equipment have been developed to meet needs as they arise. The company has also published a bulletin on the Otis Escalator, which is coming into more and more extensive use. The bulletin is a reprint from an article appearing in the *World's Work*. In this article the statement is made that there are today 250,000 people carried each day on Escalators, showing the recent growth of this device since the first installation at the Paris Exposition in 1900.

THE MINERALLAC ELECTRIC COMPANY, Chicago, Ill., recently distributed bulletin No. 51 on the subject of its graphic recording meter. This instrument furnishes a record of the exact consuming of power for every minute, in the form of a curve made up of adjacent holes punched in a paper tape. The ordinates of this curve are proportioned to the amount of power consumed in the preceding one-minute interval, the maximum demand of the period of a month naturally appearing as the highest point in the curve. Bulletin No. 52 published by the same company taking up the subject of cable joints on underground high-tension lines gives information as to the material used, together with the method of making the joint. The processes of filling, sealing, etc., are taken up and are made clear by illustrations.

DATES AHEAD.

National Electrical Contractors' Association. Niagara Falls, N. Y., July 19-21.

Ohio Electric Light Association. Annual convention, Cedar Point, O., July 25-28.

International Association of Municipal Electricians. Annual convention, St. Paul, Minn., September 12-15.

American Electrochemical Society. Twentieth general meeting, Toronto, Canada, September 21 to 23.

American Mining Congress. Thirteenth annual meeting, Chicago, Ill., September 25-30.

American Electric Railway Association. Annual convention, Atlantic City, N. J., October 9-13.

Association of Railway Electrical Engineers. Annual convention, La Salle Hotel, Chicago, November 6-10.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) June 20, 1911.

995,434. ELECTRICAL COOKING VESSEL. Friedrich Bolling, Oberursel, near Frankfort-on-the-Main, Germany, assignor to Prometheus Electric Co., New York, N. Y. Filed Oct. 4, 1910. The vessel is surrounded by a circular heating element. The latter is secured to the vessel by a wedge inserted between the heating element and an outer retaining ring.

995,435. ELECTRICAL RESISTANCE. Friedrich Bolling, Oberursel, near Frankfort-on-the-Main, Germany, assignor to Prometheus Electric Co., New York, N. Y. Filed Oct. 4, 1910. The heating element for the above consists of an insulated resistance ring with terminal contact clips.

995,438. CONTROLLER. Herbert W. Cheney, Milwaukee, Wis., assignor to Allis-Chalmers Co. Filed Sept. 13, 1909. Is arranged to connect a motor to various sets of multiple-voltage mains, a resistance being included in the armature circuit at each change of mains and a relay governing the cutting out of this resistance.

995,441. DYNAMO-ELECTRIC MACHINE. Walter P. Dandliker, West Allis, Wis., assignor to Allis-Chalmers Co. Filed Oct. 1, 1910. The end turns of the coils on the stator core have rods with washers passing through them to separate the adjacent turns.

995,447. FLASH-LIGHT APPARATUS. Charles Patterson Filson, Steubenville, Ohio, assignor to James H. Smith & Sons Co., Chicago, Ill. Filed Nov. 28, 1910. Consists of a flash-light closure with one side transparent and containing a flash lamp with an electric incandescent focusing lamp on each side of the flash lamp and separated from it by a shield to protect it from the explosion of the flash powder.

995,469. INDUCTION-MOTOR. Earle R. Knight, Norwood, Ohio, assignor to Allis-Chalmers Co. Filed April 30, 1909. The rotor has a short-circuiting ring having openings which receive the ends of the bars, and radially arranged spreading members inserted in the slotted ends of the bars and extending inwardly beyond the the latter so as to act as fan blades.

995,476. ELECTROLYTIC PROCESS. Robert J. McNitt, Niagara Falls, N. Y., assignor to Roessler & Hasslacher Chemical Co., New York, N. Y. Filed Sept. 30, 1909. The method of positively circulating a fluid electrode from and to an electrolytic cell consists in reducing the density of the electrode by charging it with the products of electrolysis and subsequently increasing the density of the charged electrode by removing some or all of the products of electrolysis.

995,481. PROCESS OF EFFECTING REDUCTION AND PRODUCING FERROCHROMIUM. Edgar F. Price, Niagara Falls, N. Y., assignor to Central Trust Company of New York. Filed June 26, 1907. This resistance process consists in passing an electric current through a slag-register adjacent to a charge containing carbon and combined iron and chromium and thereby heating the charge to the temperature of reduction, and separating and maintaining the resulting alloy out of contact with the carbon in the charge by an intermediate layer of slag.

995,482. AUTOMATIC REVERSING-SWITCH FOR GAS-ENGINES. James M. Rhett, Beaufort, S. C. Filed Oct. 15, 1910. A magnetically governed plunger makes and breaks the ignition circuit.

995,489 and 995,490. IGNITION SYSTEM FOR INTERNAL-COMBUSTION ENGINES. Claude L. Silva, San Diego, Cal., assignor to Percy J. Benbough, H. Coon, John A. Gillons, Clair A. Nelson, N. H. Hargrave, W. V. O'Farrell, D. A. Garra, Lyman P. Owen, A. O. Walker, N. D. Kuhlman, F. M. Madison, V. E. Hawkins, I. T. Brockett, and P. J. Benbough, San Diego, Cal. Filed Feb. 23, 1910. Includes a current source, a pair of condensers in series having their middle point grounded and their free terminals connected to the source, a timer having a ground connection, contacts controlled by the timer, induction coils having their primaries connected to the source and to the contacts, and ignition devices connected to the secondaries of the coils.

995,518. PNEUMATIC-DISPATCH-TUBE APPARATUS. Louis G. Bartlett, Somerville, Mass. Filed Apr. 6, 1908. A normally closed tube for the transmission of carriers, has a valve adapted to be opened to admit air to the tube for driving carriers, an electro-magnet connected to open the valve when energized, and means adapted to be operated by a fluctuation in the vacuum in the tube to energize the magnet.

995,528. ELECTRIC SWITCH. Howard Fisher, Packerton, Ind. Filed Aug. 9, 1909. Renewed Dec. 30, 1910. A lever connected with a telephone switchhook actuates a plunger with a latch that engages a dog to release a ratchet wheel connected with a spring-controlled rotary switch.

995,543. SPARKING PLUG. Emil Kuhn, Stäfa, Switzerland. Original application filed May 21, 1910. Divided and this application filed Nov. 22, 1910. Has a central electrode adjustably set in an insulating bushing that is screwed into a steel body.

995,588. ELECTRIC-WAVE TRANSMISSION. John H. Cuntz, Hoboken, N. J. Filed Mar. 11, 1905. A telephone cable has a central iron core about which the two insulated wires of the metallic circuit are helically wound in opposite directions, the core serving to counteract the electrostatic capacity of the cable. The windings of the microphane transmitter are also disposed about this core.

995,591. ELECTRIC HEATER. Thomas E. Fogalsang, San Francisco, Cal., assignor to Joseph A. Moroff, San Francisco, Cal. Filed June 27, 1910. An immersion water heater has a handle with a chambered extension in which are two exposed carbon electrodes on opposite sides of a water-heating space.

995,599. SWITCH-CLIP. George R. Hebden, Plainville, Conn., assignor to Trumbull Electric Manufacturing Co., Plainville,

Conn. Filed Nov. 19, 1910. A clip for a knife-blade switch has two resilient arms loosely joined by a stud with a spring washer which also serves as a stop for the blade.

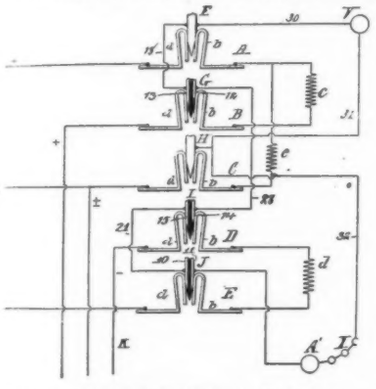
995,619. SELECTIVE SIGNALING APPARATUS. Ira F. Manny, Milwaukee, Wis., assignor to Selective Signal Co., Milwaukee, Wis. Filed Aug. 8, 1910. A motor-driven ratchet wheel is engaged by a magnetically controlled pawl and selectively operates an electric signal.

995,621. CATENARY SUSPENSION DEVICE FOR TROLLEY-WIRES OF ELECTRIC RAILWAYS. William Andrew McCallum, Cincinnati, Ohio. Filed May 24, 1909. A gripping device or head for catenary hangers embodies two "sister-hooks" opening in opposite directions, formed integrally with a common shank and provided with bearing supports for a pendulous link.

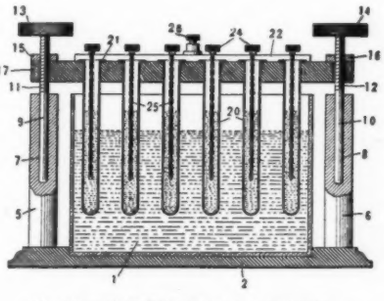
995,627. METER-TESTING CUT-OUT. Thomas E. Murray, New York, N. Y. Filed Oct. 25, 1910. A cut-out for connecting a standard meter in series with the service meter without interrupting the continuity of the supply.

995,628. ELECTRIC-CUT-OUT-BOX. Thomas E. Murray, New York, N. Y. Filed Nov. 19, 1910. Consists of a block having a passage with an open recess and two leaf-spring bars disposed in the passage edge upward and having their end portions in overlapping contact in the recess, and means in the passage for securing the bars.

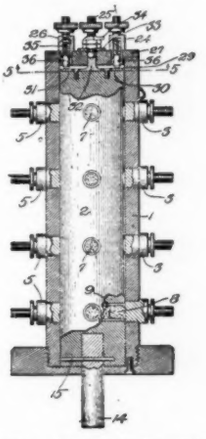
995,632. ELECTRIC MOTOR. John H. Pearce, Helena, Mont. Filed Nov. 17, 1909. A single-phase motor has three field poles,



995,627.—METER-TESTING CUT-OUT.



995,728.—ELECTRICAL COHERER.



995,774.—ROTARY SWITCH.

two of which are A-shaped in cross section and the third shaped like an inverted U, each field having two separated pole faces. The alternating source is connected to a coil on the cross bar of the first pole; a secondary coil on the yoke of this pole is connected to a coil on the cross bar of the second pole and the secondary coil on the yoke of this pole is connected to a coil on the yoke of the third pole.

995,634. TRAIN-RECORDING APPARATUS. Franklin A. Pierce, Wheeling, W. Va. Filed Mar. 26, 1909. Circuit terminals are placed at section points along the track. Passage of a train actuates recording apparatus in circuit with the terminals so as to indicate both the passage and direction of the train.

995,637. ELECTRIC METER. Gustave A. Scheeffer, Indianapolis, Ind., assignor to Columbia Meter Co., Indianapolis, Ind. Filed Jan. 26, 1910. The casing for a motor-type meter is supported by several posts secured to the base plate. About one of the posts is a spool upon which a resistance coil is wound in sections.

995,638. BRACE FOR LIGHTNING-ROD TOPS. William C. Shinn, Lincoln, Nebr. Filed July 26, 1910. Comprises two flexible standards united at their top and having supporting legs at their lower ends, and a loop carried by each of the standards and arranged to be brought into alinement with each other against the tension of the standards.

995,643. SPLICING-SHIELD FOR TROLLEY-WIRES. George Wiedenbeck, Alameda, Cal. Filed Mar. 18, 1911. The wires are upturned into receiving channels and then wedged apart by a central screw wedge.

995,646. MEANS FOR OPERATING ELECTROMAGNETS FROM ALTERNATING-CURRENT SOURCES. George M. Willis, Chicago, Ill., assignor of one-half to Alfred Stromberg, Chicago, Ill. Filed Nov. 27, 1908. A non-inductive resistance is connected across the terminals of the electromagnet and a rectifier is connected into one side of the line.

995,648. CONVEYER. Samson D. Wright, Cleveland, Ohio. Filed Oct. 4, 1907. Comprises an endless track, an endless series of cars or conveyers, part of the latter being equipped with electric motors, means for supplying current to the motors, and means for controlling all the motors from a single point.

995,674. MULTIPLE-WIRE PLUG. Harry Hertzberg and Maurice J. Wohl, New York, N. Y., assignors to Economy Electric Co., Brooklyn, N. Y. Filed Aug. 23, 1907. An insulating block is divided into three longitudinal sections with registering recesses containing metallic terminals that are clamped in place when the sections are united by an external casing.

995,676 APPARATUS FOR THE ELECTRIC IGNITION OF LARGE INTERNAL-COMBUSTION ENGINES. Gottlob Honold, Stuttgart, Germany. Filed Apr. 7, 1908. Comprises a rotary interrupter lever, normally stationary cam blocks adapted to engage and trip the lever, and means for adjusting the cam blocks relatively to each other along the path of the interrupter lever.

995,681. ELECTRIC LAMPLIGHTING DEVICE FOR AUTOMOBILES. Howard H. Kanagy, Joliet, Ill. Filed Mar. 16, 1910. Combined with a valve, is an electric contact-piece, a cross-head on the valve-stem, arms connected with the cross-head, and a spring-retracted push-button provided with a spring-extension engageable with the arms to open the valve and contact with the piece upon each alternate depression of the push-button, and close the valve upon each intermediate depression thereof.

995,685. RAIL-BOND. George W. Knox, Chicago, Ill. Filed Dec. 15, 1905. The bond has a lateral projection from its terminal face that fits into a cavity in the rail and is upset, expanded and soldered therein.

995,697. DISTRIBUTOR FOR ELECTRIC IGNITION SYSTEMS. Walter L. Marr, Flint, Mich. Filed Aug. 27, 1908. Includes an insulated shaft with radial segmental arms adapted to swing into register with the end of a stationary terminal.

995,702. FUSE-BOX. Patrick J. McDonald, Rochester, N. Y., assignor of one-half to George H. Smith, Rochester, N. Y. Filed Mar. 18, 1908. Has open-ended hollow terminals on a support, and a removable fuse carrying terminals at opposite ends, each formed to pass through one of the hollow terminals and having locking devices to engage below the lower end of the latter.

995,704. TELEPHONE-SUPPORT. Kempster B. Miller and William Kaisling, Chicago, Ill. Filed Sept. 16, 1908. Serial No. 453,333. Consists of a toothed member fixed with reference to vertical movement, a toothed member adapted to receive and hold a telephone, a straight tube connecting the two members and pivotally attached to both of them, a rod slidable with respect to the tube and engaging the teeth of both the toothed members, and a spring between the rod and tube, both the latter being contained within the tube.

995,728. ELECTRICAL CONDENSER. Augustus Kellogg Sloan, Jr., Brooklyn, N. Y. Filed Nov. 19, 1909. Comprises a number of dielectric members, each containing a conducting fluid, a supporting frame for these members, a conductor borne on the frame and flexible and removable conductors intermediate the conductor and dielectric members.

995,730. MOTOR-CONTROLLER. William C. Stevens, Pittsburg, Pa., assignor to Cutler-Hammer Manufacturing Co., Milwaukee, Wis. Filed June 1, 1909. Provides automatic means for slowing down the motor, and means for automatically disconnecting the motor from circuit upon failure of the first mentioned means to operate.

995,731. MAGNETIC SPEEDOMETER. John K. Stewart, Chicago, Ill. Filed June 17, 1910. Combined with a case, is a magnet and an armature, the former having a shaft and mounted for rotation; a non-magnetic disk interposed between the magnet and armature, the inner end of the shaft of the rotary element being axially chambered; a hanger rigid with the case extending into the chamber, the disk having a spindle which is stepped in the hanger; and a spring for biasing the disk toward a predetermined position of rest.

995,739. REFLECTOR. Elmer W. Utzler, Pittsburg, Pa. Filed June 14, 1910. The combination of a double-sided supporting frame, a reflector carried thereby, and a separately adjustable incandescent-lamp bracket carried by the frame adapted to adjust the lamp vertically and laterally.

995,763. ELECTRIC CIGAR-LIGHTER. Raymond W. Baker, New York, N. Y., Victor L. King, Woodridge, N. J., and Herschel C. Parker, New York, N. Y., assignors to Parker-Clark Electric Co., New York, N. Y. Filed Dec. 29, 1909. Has a filament-form heating element located between two sets of openings.

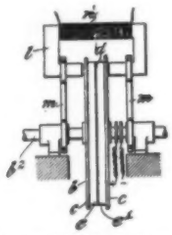
995,767. ELECTRIC SWITCH. Joseph H. Champ, Cleveland, O. Filed Mar. 28, 1910. A yoke mounted so it may oscillate carries a glass tube containing mercury between two conducting terminal blocks, one of which has a hole through it for the insertion of a wire.

995,772. INCANDESCENT-ELECTRIC-LAMP SOCKET. James S. Crossley, Solvay, N. Y., assignor to Pass & Seymour, Inc., Solvay, N. Y. Filed Oct. 6, 1910. Relates to details of the key switch.

995,774. ROTARY SWITCH. Willard E. Dow, Braintree, Mass. Original application filed Sept. 13, 1907. Divided and this application filed July 29, 1910. Has a tube, a turnable member fitting snugly therein, radial terminals in the tube, and spring-projected connected contacts in the rotary member for making contact with the radial terminals on rotation.

995,778. ELECTRIC-LIGHTED FINDER. Frank L. Fitch, Santa Cruz, Cal. Filed Aug. 3, 1910. A tubular casing has an incandescent lamp fitted into its end and protected by a guard.

995,797. ELECTRIC CLOCK. Carl E. Mathiesen, Chicago, Ill. Filed Nov. 19, 1910. An electromagnet operates an oscillatory frame to which is connected a spider with a wiper and lifting toe for actuating the clock mechanism and controlling the magnet contacts.



996,022.—MAGNETIC BELT DRIVE.

995,830. DETACHABLE COUPLING FOR TROLLEY POLES. Oscar W. Smith, Springfield, O. Filed Apr. 11, 1910| The pole base has a socket that is adapted to fit into a recess of the support.

995,838. KNOB FOR ELECTRIC WIRING. Fred B. Bower, Penn Yan, N. Y., assignor of one-half to Edia R. Ramsey, Penn Yan, N. Y. Filed July 27, 1910. Comprises two similar elements adapted to interlock to hold wires there-between, each consisting of a base and two diametrically arranged posts, the posts to each element slidably mounted between and separating the posts of the other element.

995,839. INSULATED RAIL-JOINT. Bancroft G. Braine, New York, N. Y., assignor to Rail Joint Co., New York, N. Y. Filed June 27, 1907. Splice bars are arranged on each side beneath the head and along the web. Beyond these and grasping the base flanges are other splice bars insulated from the rails, bolts and first bars.

995,842. INSULATED RAIL-JOINT. Christian J. Buck, Gallitzin, Pa., assignor to Rail Joint Co., New York, N. Y. Filed Feb. 23, 1909. The filler members have an angular recess into which fits an insulated splice bar.

995,849. SIGNALING DEVICE FOR TELEPHONE SYSTEMS. Addis J. Dunton, Ketchikan, Alaska. Filed July 7, 1910. The transmitter and receiver at each of two connected stations are placed adjacent each other. Removal of the receiver at one station actuates a relay that sets up a whistling sound at the other station.

995,867. ILLUMINATED TARGET-FINDER. Herman J. Hegwer, Oakland, Cal., assignor to Hegwer Illuminated Target Finder Co. Filed Jan. 7, 1910. Below the barrel of a revolver or gun is a casing containing a lens, miniature electric lamp and dry cell. A spring arm on the handle closes the lamp circuit.

995,878. INDICATOR FOR SPARK-PLUGS. Addison R. Lamberson, Albany, N. Y. Filed Dec. 1, 1910. A spark-plug tester comprises a tubular case which contains a miniature electric lamp and contact washer at one end and a peep hole at the other.

995,893. ELECTRIC-CONDUIT CONNECTION AND COUPLING. Otto M. Neitzel, Kingfisher, Okla. Filed May 3, 1909. A conduit support has an aperture for receiving the conduit and oppositely disposed leaf springs to grip the conduit.

995,910. RAILWAY-CROSSING SIGNAL. Peter S. Russell, Stevensville, Mont. Filed March 11, 1911. Adjoining the rail head is a block on top of which is a normally open spring switch that is closed by passage of a train.

995,924. TELEPHONE SYSTEM. Jackson B. Stemm, Chicago, Ill., and George E. Slade, Brookfield, Mo. Filed Apr. 11, 1910. Combined with two diaphragms is a permanent horseshoe-magnet having its bend secured centrally to each of the diaphragms with its limbs projecting perpendicularly therefrom, stationary induction coils loosely encompassing the limbs of the magnets, and an electric circuit connecting the coils.

995,958. OZONATOR. Louis Goldberg, Indianapolis, Ind. Filed Feb. 10, 1911. A tubular casing contains two concentric tubular electrodes having corresponding projections.

995,970. INCANDESCENT-LAMP SOCKET. Elda M. Kemp, Hibbing, Minn. Filed Mar. 21, 1911. Comprises a base block, lamp-holding means carried thereon, a disk provided with slots therein and secured to the block, contact members detachably carried by the block and passing through the slots, and a spacing member secured to the disk.

995,989. SPARK-PLUG. Joseph E. Schaefer, Jr., Detroit, Mich. Filed July 28, 1910. Relates to details of construction.

996,011. METHOD OF MAKING NITROGEN COMPOUNDS. Albert R. Frank, Halensee, near Berlin, Germany, assignor to Società Generale per la Cianamide, Rome, Italy. Original application filed Mar. 13, 1907. Divided and this application filed June 8, 1910. Consists in electrically heating a relatively small part of a carbide mass to a reacting temperature, supplying nitrogen as the reaction proceeds, thereby maintaining the temperature, and continuing the reaction throughout the mass to be converted.

996,019. POWER ARMATURE-BANDER. Alfred J. Hunter, Bayonne, N. J. Filed Apr. 30, 1909. Combined with a tension arm having a groove extending lengthwise thereof, is a guide roller journaled at each end of the groove, and tension plates positioned in the groove.

996,022. BELT-DRIVE. Povl. T. Lindhard, New York, N. Y., assignor to F. L. Smidth & Co., New York, N. Y. Filed Aug. 27, 1910. Combined with a magnetic belt are belt pulleys, means to magnetize one of the pulleys, a belt tightener applied to the slack side of the belt, and means to demagnetize the magnetic pulley.

996,032. PROCESS FOR THE MANUFACTURE OF ALUMINUM NITRIDE. Ottokar Serpek, Paris, France, assignor to Société Generale Des Nitrures, Paris, France. Filed June 21, 1910. The apparatus comprises as an element therof a rotary conveying cylinder carrying an electric resistance furnace through which the material treated is passed.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired June 26, 1911:

521,791. MACHINE FOR MAKING STORAGE-BATTERY GRIDS OF FORCED LEAD. William W. Griscom, Haverford, Pa.
521,798. ELECTRIC-ARC LAMP. S. P. Johnson, Schenectady, N. Y.
521,799. ELECTRIC MOTOR. Joseph Lee, Brooklyn, N. Y.
521,800. SOUND-CONDUCTING APPARATUS. George A. Leech, New York, N. Y.
521,809. ELECTRIC-LAMP LIGHTER. James F. McLaughlin, Philadelphia, Pa.
521,840. ELECTRIC ALARM CLOCK. Nina F. Whitney, Columbus, O.
521,867. CONTROLLER FOR ALTERNATING-CURRENT MACHINES. Edmund B. V. Seavers, Brookline, Mass.
521,877. ELECTRIC-ARC LAMP. William J. Davy, London, Eng.
521,892 and 521,891. CONDUIT ELECTRIC RAILWAY. Charles J. Reed, Orange, N. J.
521,908. AUTOMATIC SAFETY-JOINT FOR ELECTRIC WIRES. James H. Curry, Wilkinsburg, Pa.
521,914. ELECTRIC SOLDERING TOOL. James F. McLaughlin, Philadelphia, Pa.
521,924. TRANSFORMER ELECTRIC-LIGHTING SYSTEM. Peter Wright, Philadelphia, Pa.
521,925. TRANSFORMER SYSTEM OF ELECTRICAL DISTRIBUTION. Peter Wright, Philadelphia, Pa.
521,936. ELECTRIC-ARC LAMP. Louis B. Marks, New York, N. Y.
521,952. ADJUSTABLE CARRIER FOR ELECTRIC LAMPS. Robert Faries, Decatur, Ill.
522,029. ELECTRIC TIME-SIGNALING SYSTEM AND APPARATUS. Walter A. Purcell, Newark, N. J.
522,051. BRUSH HOLDER FOR DYNAMO-ELECTRIC MACHINES. Rudolph Fuller, Detroit, Mich.
522,055. CIRCUIT-MAKER. Daniel F. Hall, Schenectady, N. Y.
522,067. MEANS FOR SUSPENDING ELECTRIC MOTORS FROM CARS. Robert Lundell, Brooklyn, N. Y.
522,083. DYNAMO OR MAGNETO-ELECTRIC MACHINE. Leonard Paget, New York, N. Y.
522,097. ELECTRICALLY-OPERATED ADDING MACHINE. Robert Baumann, St. Louis, Mo.
522,127. VOLTAIC BATTERY. Henry Timm, New York, N. Y.
522,151. METHOD OF HEATING METALS ELECTRICALLY. Charles L. Coffin, Detroit, Mich.